Designing for an inclusive school of informatics for blind students

a learning perspective

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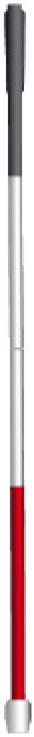
DESIGNING FOR AN INCLUSIVE SCHOOL OF INFORMATICS FOR BLIND STUDENTS

A LEARNING PERSPECTIVE



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Aalborg, Denmark. 2012

Metamorphosis from geometric shapes

Cover motivation

The cane and Braille achieved in the physical world to break down barriers and allow accessibility and inclusion of visually impaired people in society. Both elements are represented graphically (color and shape) and used the resource of metamorphosis (change in form and space), creating a process of transformation into a virtual environment represented by squares (pixels). "breaking barriers", cause changes under the principle of equality to the accessibility of a blind person to a virtual environment, providing all the facilities (space, methodological, technical, etc.) To successfully pursue the career of computing.

Karen Herrera (Graphic Designer)

DESIGNING FOR AN INCLUSIVE SCHOOL OF INFORMATICS FOR BLIND STUDENTS. A Learning Perspective

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ABSTRACT

Today it is not uncommon to see disabled people attend universities. These include in particular mobility impaired people and blind people, but they are not the only ones, as other impairments can for example be hidden under the ‘normality’ of other students, teachers and administrative staff at universities.

As a university teacher it became obvious to me that there were no blind students at the School of Informatics at Universidad Nacional UNA in Costa Rica. This is surprising as this school has some of the university’s most attractive programmes. I learned that most of the blind people who were enrolled in UNA attended education careers programmes or philosophy. So I asked myself: Why are blind people not interested in studying informatics? Then I learned about a blind student who was interested in enrolling in the system engineering career programme a few years ago, but she quit from her initiative to do so.

It was at that moment that I shifted my focus from trying to understand why blind students were not interested in informatics and started to question whether the School of Informatics was prepared to receive blind students. As I was a teacher in this school I could start by asking myself this question. I had no idea whether blind students could study computer sciences, how I could interact with them, and what they would expect and require from me. I asked other teachers in the school, but they were equally unable to answer my questions, and this led me to conclude that the answer to the first question was no: we were not prepared to receive blind students.

This is what this thesis is about: how the School of Informatics can prepare itself to receive blind students. There are multiple objectives for approaching this question. It was fundamental for me to learn about blindness from the point of view of social construction, from the formal perspectives of people, researchers and advocates who deal with blindness. I wanted to learn about the tools they use, how the educational environment acts and reacts to blind students and, most importantly, how blind students cope with tertiary education.

A literature review on blindness, a representative tool for blind people, Wenger's social theory of learning as a theoretical framework and my empirical study of first-hand experiences; these elements support each other in my work to define a solid framework for understanding the phenomenon of blindness in higher educational environments. The empirical study was inspired by ethnography, grasping three blind students' experiences in tertiary education in order to illustrate their perceptions of the surrounding world and clarify the situations they have to face every day as well as their relation to the educational environments. They also provide rich feedback about the role these educational environments and other supporting institutions play in their studies and their future incorporation in the work force.

On the basis of this framework we can identify the continuities and discontinuities in educational environments in the inclusion process. The research has showed the significance of their participation in the educational context for their learning processes and professional futures.

The research proposes a repertoire to define:

- A general and pragmatic categorisation of blindness: blind people who rely on Braille to read and write, and partially sighted people who can read printed material with the use of magnifiers or other supportive tools.
- The social construction of blindness, drawing on four different models: the charity model, the medical model, the rights-based model and the economic model.
- A classification of different perspectives according the contributions of people who working towards inclusion. The four perspectives are: the medical perspective, the adaptive perspective, the integrative perspective and the inclusive perspective.

- A classification to determine the progress of institutional inclusion processes, defined by three levels: the entry level, the level of getting into inclusion level and the desired level of inclusion.

Under these classifications it was determined that the educational environments related to the fieldwork were at the entry level, and the initiatives in those contexts were related to the adaptive perspective. Furthermore, it was established that some parts of the educational environments needing to concentrate on ensuring better conditions for blind students.

To generate sustainable solutions, knowledge of blindness in the educational context must be improved, and I would argue that it is mandatory to include research in this process. With this knowledge, then, it is needs to design for inclusion, designing for the majority of students' necessities, not for particular populations. This design should eventually generate a single practice, as different practices converge, each defined by the variety of student practices.

As a strategy universities should incorporate inclusion topics in the curricula to teach their students about their responsibility to establish inclusion in their future work. This strategy is discussed as an efficient tool for improving the understanding of blindness and for easing the negotiability of practices between different populations. Therefore, this strategy contributes to the inclusion of blind students in these educational environments.

Specialised offices in each university will benefit the incorporation of policies, knowledge and understanding in the educational context to ease the inclusion process. Also, these offices should be the natural facilitators introducing the strategies to achieve the desired level of inclusion.

As part of the fieldwork a workshop series was used to gather information, but it is also presented as an introductory tool for initiating inclusion processes.

The discussion of tools was divided into two: a discussion from the point of view of the tools offered in the market and a discussion from the point of view of tools required for studying computer sciences. Some of these tools are available, but can only be implemented if teachers and students receive training in using them, others are already in use by students, and still others are waiting to be developed.

Identity issues require special attention. A conclusion is that it is fundamental for blind students to have a strong blind identity to negotiate their practices and that these practices are not subjugated to the dominion of the dominant practice.

Finally, this thesis will contain more questions than answers, but the questions are the detonators that improve a process that probably started a long time ago, but needs to be reoriented to be more effective and efficient in ensuring equal opportunities for blind and sighted students, particularly in connection with system engineering or other computer science-related career programmes.

RESUME

Det er ikke usædvanligt at studerende med et handikap deltager i universitetsuddannelse. Disse omfatter i særdeleshed bevægelseshæmmede og blinde personer, men inkluderer også andre typer, f.eks. mindre åbenlyse handikap, som eksempelvis kan gemmes under ’det normale’ blandt andre studerende, undervisere og administrativt personale på universiteterne.

Som universitetsunderviser blev det klart, at der ikke var nogle blinde studerende på ”School of Informatics” på Univrsidad National (UNA) i Costa Rica. Dette var overraskende for mig, da dette studieområde har nogle af universitets mest attraktive uddannelser. Jeg erfarede, at mange blinde studerende på UNA gik på uddannelser indenfor undervisning, filosofi eller jura. På den baggrund var det nærliggende at stille spørgsmålet: hvorfor er blinde ikke interesserede i at læse informatik? Imidlertid erfarede jeg for nogle år siden, at en blind studerende faktisk skiftede studie fra Systems Engineering til school of engineering.

Dette flyttede mit fokus fra at prøve at forstå, hvorfor blinde studerende ikke interesserer sig for informatik, til at stille spørgsmålstegn ved hvorvidt School of Informatics var klar til at modtage disse studerende. Som underviser i denne afdeling kunne jeg passende starte med at stille mig selv dette spørgsmål. Jeg vidste slet ikke om blinde kunne studere informatik, hvordan jeg kunne arbejde sammen med dem og endnu mindre undervise dem, og hvad ville de egentligt forvente og behøve fra mig? Jeg spurgte andre undervisere i afdelingen, men de var på samme måde som mig selv ude af stand til at besvare mit spørgsmål, hvilket gjorde at jeg måtte konkludere at svaret til det første spørgsmål var nej. Vi var ikke klar til at modtage blinde studerende.

Det er dette som denne afhandling omhandler: Hvordan kan School of Informatics forberede sig på at kunne modtage blinde studerende og skabe et inkluderende læringsmiljø? For at besvare dette spørgsmål er der mange delspørgsmål som skal besvares. For det første skal der udvikles en forståelse af blindhed. I afhandlingen præsenteres en teoretisk forståelse af

blindhed, som baserer sig på en social konstructionistic forståelse. Desuden har det været fundamentalt for mig at lære fra de personer, forskere og professionelle, som arbejder med blindhed. Jeg har været interesseret i at lære om de redskaber de blinde bruger, hvordan uddannelsesmiljøet opfører sig og reagerer på blinde studerende og vigtigst, hvordan blinde studerende oplever og håndterer det at være studerende på en videregående uddannelse.

Afhandlingen bygger således på følgende elementer: et litteraturstudie af blindhed, et afsnit om redskaber for blinde, et afsnit om Wengers (1998) sociale læringsteori, som danner en teoretisk ramme for projektet og mit empiriske studie af blinde studerendes og undervisers førstehåndsoplevelser med at deltage i videregående uddannelsesforløb. Det er disse elementer, der danner basis i mit arbejde for at forstå fænomenet blindhed indenfor de videregående uddannelser. Mit empiriske studie er inspireret af etnografi og omhandler tre blinde studerendes oplevelser som aktive studerende på en videregående uddannelse. Disse studier præsenterer de studerendes opfattelse af omverdenen og tydeliggør de situationer, som de står over for hver dag samt deres responser til forskellige uddannelsesmiljøer. Samtidig giver de studerende også detaljeret feedback omkring hvilken rolle disse uddannelsesmiljøer og andre institutioner spiller i deres studier og deres fremtidige muligheder på arbejdsmarkedet.

På baggrund af det teoretiske og empiriske grundlag identificerer afhandlingen kontinuiteterne og diskontinuiteterne i inklusionsprocessen i uddannelsesmiljøerne:

- En generel og pragmatisk kategorisering af blindhed: blinde er afhængige af punktskrift for at læse og skrive, medens synshæmmede kan læse ved hjælp af forstørrelsesglas og andre redskaber.
- En social konstruktion af blindhed, som bygger på fire forskellige modeller: velgørenheds modellen, den medicinske model, rettighedsmodellen og den økonomiske model..

- En klassificering af begrebet om blindhed, som bygger på forskellige perspektiver: det lægelige perspektiv, det adaptive perspektiv, det integrative perspektiv og det inkluderende perspektiv.
- En klassificering af udviklingen af den institutionelle inklusionsproces defineret ved hjælp af de følgende tre niveauer: Indgangsniveauet; niveauet, hvor inklusion finder sted; og det ønskede niveau for inklusion.

På baggrund af disse klassificeringer er det dokumenteret gennem feltarbejdet, at uddannelsesmiljøerne kun er på "indgangsniveauet", og initiativerne i disse kontekster var relateret til det adaptive perspektiv. Endvidere blev det fastslået at dele af uddannelsesmiljøerne har brug for øget fokus på de blinde studerendes forhold for at sikre en forbedring af læringsmiljøerne for disse.

For skabe varige løsninger må viden om blindhed i uddannelsesmæssig kontekst forbedres, og jeg argumenterer her for at det burde være obligatorisk at inkludere forskning i denne proces. Med denne viden er det tydeligt af det er nødvendigt at have fokus på inklusion, designe en fremgangsmåde for majoriteten af de studerendes behov og ikke for minoriteter. Dette design burde med tiden skabe en enkelt praksis, i takt med at andre fremgangsmåder, som er defineret af de forskellige studerende, konvergerer.

Som en strategi burde universiteter inkorporere inkluderings emner i pensum for at lære de studerende om deres ansvar for at etablere inklusion i deres fremtidige arbejde. Denne strategi er omtalt som et effektivt redskab til at fremme forståelsen af blindhed og for at lette kommunikationen i mellem forskellige grupper. Derfor bidrager denne strategi til inklusion af blinde studerende i disse uddannelses miljøer.

Specialiseret personel på hvert universitet skal fremme inkorporationen af strategien, viden og forståelse i uddannelsesmæssig kontekst for at lette inklusionsprocessen. Endvidere, skal dette personel være de naturlige facilitatorere til at introducere strategien for at opnå det ønskede inklusionsniveau.

En serie af workshops blev gennemført som en del af feltarbejdet for at indsamle information, men er også præsenteret som et introduktionsredskab for at igangsætte inklusionsprocessen.

Diskussionen omkring redskaber blev delt i to: en diskussion med henblik på eksisterende redskaber på markedet og en diskussion med henblik på redskaber, som er nødvendige for informatik studiet. Nogle af disse redskaber er tilgængelige, men kan kun implementeres i undervisningen hvis undervisere og studerende får træning i brugen af dem, andre er allerede i brug blandt studerende, og andre igen er endnu ikke blevet udviklet.

Identitetsproblematikker kræver særlig fokus. En konklusion er, at det er fundamentalt for blinde studerende, at udvikle en stærk identitet for at kunne diskutere deres fremgangsmåder, således at disse ikke bliver underlagt de dominerende fremgangsmåder.

Afslutningsvis vil denne afhandling indeholde flere spørgsmål end svar. Spørgsmålene fungerer imidlertid som igangsættere, som skal fremme en proces der højst sandsynligt startede for lang tid siden, men som har brug for at blive styret i mere effektiv retning for at sikre lige muligheder for blinde og almindeligt seende studerende. Denne afhandling har særligt fokus på denne problemstilling i forbindelse med Systems Engineering og andre datalogi relaterede uddannelser.

RESUMEN

Hoy día no es infrecuente encontrarse con personas discapacitadas en nuestras universidades. Particularmente podemos notar las personas con limitaciones de movimiento y personas ciegas, pero ciertamente no son las únicas, puesto que otras limitaciones pueden estar ocultas tras la 'normalidad' de otros estudiantes, profesores y personal administrativo de las universidades.

Como profesor universitario, fue obvio para mí que no había estudiantes ciegos en la Escuela de Informática de la Universidad Nacional UNA en Costa Rica. Esto sorprende ya que esta escuela tiene uno de los programas con mayor atracción estudiantil. Ahí me percaté que la mayoría de los estudiantes ciegos de la UNA se matriculaban en carreras de educación o filosofía. Esto me hizo preguntarme ¿por qué los estudiantes ciegos no se interesaban en estudiar Informática? Después me enteré que años atrás una estudiante ciega se interesó en matricularse en la carrera de ingeniería de sistemas y al final desistió de su intento.

Fue en ese momento cuando mi interés en el tema cambió para tratar de entender por qué los estudiantes ciegos no se interesaban en la informática como carrera y con ello a preguntarme si la Escuela de Informática estaba preparada para recibir estudiantes ciegos. Siendo profesor de esta Escuela, empecé a auto cuestionarme. En ese momento no tenía idea si los estudiantes ciegos podrían cursar una carrera del área de las ciencias de la computación, tampoco sabía como podría interactuar con ellos y que esperarían y requerirían de mí. Hice las mismas preguntas a otros profesores de la escuela y ellos tampoco tuvieron respuestas, lo cual me llevó a concluir que la respuesta a la pregunta inicial es que no, la Escuela no estaba preparada para recibir estudiantes ciegos.

Este es el tema central de esta tesis: ¿Cómo la Escuela de Informática puede prepararse para recibir estudiantes ciegos? Hay múltiples objetivos para tratar esta pregunta. Pero primero era fundamental para mí aprender acerca de la ceguera, desde el punto de vista de la construcción social; así como desde las perspectivas formales de los investigadores y personas

dedicadas a tratar con la ceguera. Quise aprender sobre las herramientas que usan las personas ciegas, cómo el ambiente educativo actúa y reacciona hacia los estudiantes ciegos y lo más importante, cómo los estudiantes ciegos manejan su educación terciaria.

Para esto se realizó una revisión bibliográfica acerca de la ceguera, una revisión de herramientas representativas para personas ciegas, el estudio de la teoría social de aprendizaje de Wenger como marco teórico y mi trabajo de campo para obtener experiencias de primera mano. Estos elementos juntos establecieron un marco sólido para entender el fenómeno de la ceguera en un ambiente educativo post secundaria. El estudio de campo se inspiró etnográficamente, aprendiendo de las experiencias de tres estudiantes ciegos en la educación terciaria, con la finalidad de obtener sus percepciones del mundo que los rodea y clarificar las situaciones que deben enfrentar en su vida diaria y con su ambiente educativo. Estos estudiantes también aportaron mucha riqueza a la investigación con respecto al rol que juegan sus ambientes educativos y las instituciones que los apoyan en sus estudios y en su incorporación futura en la fuerza laboral.

De las bases de este sólido marco, podemos identificar las continuidades y discontinuidades en los ambientes educativos con respecto al proceso de inclusión. La investigación mostró la relevancia de la participación de los estudiantes en el contexto educativo para su proceso de aprendizaje y su futuro profesional.

Este trabajo propone un repertorio para estandarizar conceptos:

- Una categorización general y pragmática de la ceguera: Persona ciega es aquella que requiere del Braille para leer y escribir, mientras que identificaremos a las personas parcialmente videntes como aquellas personas que pueden leer materiales impresos con el uso de magnificadores u otra herramienta de soporte.
- La construcción social de aprendizaje estará identificada por cuatro modelos: el modelo de caridad, el modelo médico, el

modelo basado en los derechos de las personas y el modelo económico.

- Una clasificación de cuatro diferentes perspectivas según la contribución que los diferentes grupos hacen al proceso de inclusión: la perspectiva médica, la perspectiva adaptativa, la perspectiva integrativa y la perspectiva inclusiva.
- La definición del grado de progreso de una institución en el proceso de inclusión por medio de tres categorías: el nivel inicial, el nivel de ingreso al nivel de inclusión y el nivel esperado de inclusión.

Bajo estas clasificaciones se ha determinado que los ambientes educativos involucrados en esta investigación se encuentran en un nivel inicial y las iniciativas están basadas en una perspectiva adaptativa. También se estableció la urgencia de atender algunas áreas de estos ambientes educativos para asegurar mejores condiciones para los estudiantes ciegos.

Para dar sostenibilidad a las soluciones que se planteen, se requiere generar más conocimiento sobre la ceguera en los ambientes educativos, para lo cual es requerida más investigación. Con este conocimiento se podrá diseñar para la inclusión, diseñar para la mayoría de las necesidades de los estudiantes y no para soluciones particulares. Este diseño debe tender a generar una única práctica, obtenida a partir de la convergencia de las diferentes prácticas provenientes de las prácticas de la diversidad de estudiantes.

Como estrategia se propone la incorporación de los tópicos de inclusión en la currícula, para enseñar a los estudiantes su responsabilidad del uso de prácticas inclusivas en su trabajo futuro. Esta estrategia es discutida como una eficiente herramienta para mejorar la compresión de la ceguera y así facilitar la negociación de las prácticas entre diferentes poblaciones. Luego, esta estrategia también contribuirá al proceso de inclusión de los estudiantes ciegos en sus propios ambientes educativos.

Las oficinas especializadas en cada universidad serán de gran beneficio para la incorporación de políticas, conocimiento y entendimiento en los contextos educativos, lo cual facilitará los procesos de inclusión. Estas oficinas serán también las facilitadoras naturales para la introducción de las estrategias para alcanzar el nivel deseado de inclusión.

Como parte del trabajo de campo, se utilizó una serie de talleres de trabajo que fueron utilizados para obtener información, pero también se presentó como una herramienta introductoria para iniciar el proceso de inclusión.

La discusión de las herramientas se dividió en dos: una discusión desde el punto de vista de las herramientas ofrecidas en el mercado y otra desde el punto de vista de las herramientas necesarias para estudiar informática. Algunas herramientas están disponibles, pero requieren capacitación para profesores y estudiantes para ser usadas, otras ya están en uso por los estudiantes y hay otras que aún se deberá esperar más por ellas.

Los asuntos de la identidad requieren especial atención. Una conclusión es que es fundamental para los estudiantes tener una fuerte identidad de ciego para negociar sus prácticas y que éstas no se vean subyugadas por las prácticas dominantes.

Finalmente, esta tesis tendrá más preguntas que respuestas, pero estas preguntas son detonantes para mejorar un proceso que probablemente inició hace mucho tiempo, pero requiere ser reorientado para ser más efectivo y eficiente en asegurar iguales oportunidades para los estudiantes ciegos y los videntes, particularmente en las carreras de ingeniería de sistemas u otras carreras relacionadas.

< CHAPTER ONE >

INTRODUCTION

In 2005 the School of Informatics at Universidad Nacional received a request from the Blind Affairs Office to evaluate whether a blind student could be enrolled in the school’s System Engineering career programme. The answer was that the school was not prepared to receive blind students, as the school did not have the required infrastructure, knowledge and trained staff. This motivated me to try to answer the question: How can a blind student study System Engineering? I started working on a proposal for a local research project oriented to the provisioning of tools. I soon began to understand that this question cannot be answered simply by providing tools. Therefore, my local research started to turn into a more complex problem, and I also understood that the question should be reformulated as follows: How can the School of Informatics prepare itself to receive blind students? And so, with this main research question, the present project was born.

1.1. After defining the research question

The first consequent question that arose was: What does it mean to be blind? It is not possible to find an answer to the main research question, if the population that it addresses is not fully understood. Different concepts underpin this question, just as different focuses are at play when it comes to understanding blindness.

1.1.1. Looking at the context

Firstly, as we are interested in the phenomena of inclusion in the context of education, we need to understand blindness from the point of view that societies have constructed on blindness and how such a construction influences these students' inclusion. At the same time, the social construction of blindness is influenced by institutionalised discourses and legal frameworks. Chapter 2 is dedicated to introducing the reader to the existing situation concerning the legal framework and the institutionalisation of blindness in the western world and a number of remarkable differences between the reference countries.

Additionally, it will represent a social construction framework for identifying the responses of society to blindness. This framework provides a classification of these responses that will provide us with a common language on people's interpretation of blindness in specific situations and moments. This classification does not intend to stigmatise segments of society according to people's responses, but to understand how society understands blindness; therefore, it provides a complementary understanding of the question: What does it mean to be blind? That is, the responses that disabled people get from others which reflect how the latter think, feel and act towards the former, who become a burden in their daily lives; in some cases, these responses even create new disabilities in disabled people (Hollier, 2007).

In fact, Davis (2000) warns us not to consolidate a discourse of them and us, the oppressed and the oppressors, especially when we are working with 'the systematic demystification of structures and processes which create disability' ((Barnes, 1992, p.122) cited by Davis, 2000). Davis says that via such classifications we can:

> … reduce the importance of people as social actors, reifying the role of structure and ignoring the diverse ways in which individuals and social groups relate to and resist such structures. (Davis, 2000, p.196)

In this sense, to understand the social construction of blindness, including its historical development, it is necessary to understand important conceptualisations to depict the world or domain of blind people from society's point of view, which influences and in some cases also constructs disabilities in individuals with impairments. In other cases it provides 'a catalyst for change in how people with disabilities are perceived' (Hollier, 2007, p.22).

1.1.2. Addressing the research

As the purpose of this research is to prepare and enable the educational environment to effectively incorporate blind students into the mainstream flow, the next step is to understand the perspectives employed by the scientific community to support blindness and thus address the model that will be pursued. This establishes another framework for discussing inclusion matters. Again, this framework does not establish a sequential order of how inclusion is addressed, but how the emphasis of this support is done.

Chapter 3 will include a discussion of four perspectives or approaches to blindness. The most clear and well known is the medical perspective that is based on the notion of 'repairing' the dysfunctional organs that provoke the impairment in question. This perspective is widely criticised by groups that support inclusion, as it is based on the impairment, focusing on difficulties and problems instead of abilities and strengths. However, the medical perspective also instructs us in the physical phenomena and thus contributes to the understanding of blindness and its physical diversity, supporting the principle that categorising is in fact a mistake. Also, this perspective contributes to an understanding of how blind people can improve their interaction with a given context by using media as alternatives to sight.

The other perspectives deal with the inclusion of adaptive technology as a way to allow blind people to adapt to the sighted world. The integrative perspective seeks to incorporate blind people into mainstream society, ending with the inclusive perspective, moving society towards actual inclusion and preparing the environment and making it usable for everybody, without any restrictions. This is the focus of this research, and it is important to present it explicitly (Duckett & Pratt, 2001).

As I mentioned above, each of these perspectives can interact with the others, because understanding the physical phenomenon can ease the construction of adaptive technology which, at the same time, allows people to integrate, and if it is built in accordance with the inclusive perspective it would be designed as a tool that can be used widely in society and not exclusively by blind users.

On the other hand, alongside the development of technologies the development of tools to support blind people has rocketed. Therefore, tools have become an important issue when it comes to understanding blindness and how students in particular deal with them and their role in their opportunity to study. Chapter 4 is dedicated to presenting a collection of representative tools, giving emphasis to tools within the context of education, but also mentioning tools used in daily life that eventually could have an impact on academic activities. Such a journey through tools is another way to supplement the understanding of blindness, as we review tools that are fully integrated in the daily lives of blind people and tools that are not used by, as they do not fulfil the basic needs of this group. Among these tools are tools that explain to newcomers how blind students cope with their studies with basic contemporary tools like screen readers and digital recorders. This is also to show how old tools, like Braille Coding, have developed into electronic devices such as note takers and Braille keypads to support screen readers.

Chapter 5 is the last step in providing answers from the theoretical perspective to the secondary question: What does it mean to be blind? This question will be revisited continually throughout the thesis, as we will continue to learn from our cases of study in chapters 8, 9, 10 and 11. In the fifth chapter we will get an overview of the two contexts under discussion: the Danish and Costa Rican contexts.

1.2. Theorising

As we are dealing with learning and social interaction as a way to achieve inclusion, I find social theory of learning an interesting approach to identifying the factors that the educational context is missing in the effective inclusion of blind students into the mainstream. Concepts like participation in equal conditions, belonging to the educational context, identities, meaning negotiation, diversity and negotiability, practice and tools appropriation, social structures and experiences, institutionalisation, power, social interaction, engagement, imagination, alignment and design are all fundamental to the inclusion discussion and an inherent part of the social theory of learning (Wenger, 1998). How these concepts interact and how can they be explained by the theory is the topic of chapter 6. I will start with a conceptualisation of Wenger's two axes models considering the specific scope of this research, trying to move his theory towards basic concepts of inclusion as a support to the process of understanding the findings of the present fieldwork Then, the educational infrastructure and the learning architecture concepts (1998) are reinterpreted in function of inclusion needs and proposed as a framework for understanding possible deficiencies in educational environments.

Now, above we discussed which elements could be interesting to consider with regard to inclusion in educational contexts. Then, it is time to consider the main aspect of this discussion: the blind students who struggle with the actual educational context. In fact, the research is based on a process of sharing experiences with some blind students in their own contexts, proposing an interpretation of all the previously discussed elements. Therefore, cases of study were established to get into matters of identity, culture and structures that students recognise in their own educational contexts. According to Davis, this 'should enable the ethnographer to gain insight into how people respond to the individuals, structures and cultures they encounter on a daily basis' (2000, p.199). Indeed, as the construction of the data was inspired by ethnography, interviews, direct observation and complementary activities were used to complete the elements and provide a better understanding of what it means to be blind and, to go to the next stage of the research, how the

School of Informatics can prepare to receive blind students?. We will consider Davis:

> This form of ethnography does not run the risk of weakening feelings of collectivity amongst disabled people. It offers us the chance to illustrate different people concepts of oppression and to gather a variety of definitions of oppression. (Davis, 2000, p.199)

Then, during the fieldwork I had the opportunity to collect a considerable amount of data following the criteria defined exhaustively in chapter 7, including the considerations of the methodological choices made in this research.

1.3. Constructing data and knowledge

A Danish student of computer sciences, two Costa Rican students from Universidad Nacional (UNA), studying counselling, and a group of teachers also from UNA became the main source of data collection in the fieldwork for this research, who, via ethnographically inspired techniques, contributed substantially to an understanding of the phenomena from the blind students' perspective. Other Costa Rican students from other career programmes, a former Danish student at Aalborg University (AAU), agencies supporting blindness, teachers and AAU and UNA School of Informatics directors were a part of the process of direct source perception, complementing the data collected from the educational context. The literature on blindness that has been reviewed lacked diversity and in many cases was not detailed enough to be used as a point of departure, suggesting a more extensive process of data collection in the field. This process comprised mainly open interviews, direct observations and workshops, which are presented in chapters 8 and 9 and subsequently analysed in chapter 10.

The main data sources were the three students mentioned in the first group above; they used open interviews. They provided a lot of data about life stories, trajectories, identities, tools appropriation and wanted tools, perception of educational structures, teachers and teaching practices, participation and non-participation, limits imposed by the educational environment, opportunities, engagement, alignment and imagination. These data are presented in chapter 8 and partially in chapter 9.

Also, a double purpose workshop set was used as a tool to collect direct data for the research and as a way to experience a tool that could move the educational context towards a more inclusive environment. Both aims are presented in chapter 9. Even though the workshops are not analysed rigorously as a tool for educating the educational staff towards inclusion, it is relevant to consider and analyse in further research.

On the other hand, the workshops as a tool for data gathering were used as a way to enable teachers to express their feelings and fears, to discuss their weaknesses and strengths, their myths and limitations to understanding blindness, and as a way to recognise important components of the world of blind students' in educational contexts.

After presenting the data in chapters 8 and 9, the analysis is presented in chapter 10, addressing the continuities and discontinuities in the educational environments at university level and analysing the impact of social structures, teaching practices and existing tools as well as the lack hereof, the way students cope with their studies and identity construction. With these discussions different levels of inclusion are defined to help educational environments focus their efforts on inclusiveness concepts.

Finally, chapter 11 presents final thoughts, conclusions, recommendations and future research emerging from this one. The conclusions will highlight the findings of this research that are relevant and useful for improving the understanding of blindness, inclusion and the facts that affect the educational environments when it comes to matters of blindness. Recommendations include suggestions to improve the School of Informatics' readiness to receive blind students and some areas that require further research to determine effective solutions for the educational environments, enabling them to offer equal opportunities for all their students.

< CHAPTER TWO >

SOCIAL CONSTRUCTION OF BLINDNESS

> *For me, my disability is a fact and not a problem. I'm not living the life of a disabled person. For sure, I have to handle some things differently from other people. But it's not so different from the life of someone who is not disabled. In any case, who is really not disabled? (Thomas Quasthoff, opera singer, in (Shepherd, 2001)*

Depending on the glasses we are wearing, there are different approaches to understanding the social construction of blindness. When we want to understand the reality of blind people it is important to understand the social construction of blindness through history, because it is through history that societies have constructed their viewpoints, it is through history that laws have been produced and reality has been moulded (Hollier, 2007).

This history can be observed through the institutionalisation of blindness in two dimensions:

1. Institutional discourses that have supported a specific understanding of blindness. Such discourses can provide us with a timeline via which we can reconstruct the chronology of events that have changed the discourses and the perception of blindness.

2. Laws as an answer to national and international discourses and the demands of interested social groups.

Laws and discourses, including the ways that society perceives blindness, belong to what I in this chapter will call *social structures*, inspired by Wenger's model of social theory of learning (1998).

2.1. Social structures

It is relatively recent that disability has become part of social discourses, after 1950 when western governments realised that disabled people could mean a potential increase of the workforce. This economic interest motivated the introduction of workshops and shared accommodations to ease the participation of disabled people in the labour market (Hollier, 2007). The major implication of such policies was that people would not be able to work in other places than those designated with this purpose. This did not help improve the social perception of blindness, because these people were kept from social contact, limiting their rights as human beings (Schlesinger & Whelan, 1979 in Hollier, 2007).

Later institutions, policies and finally laws started to emerge which dealt with a new tendency, influenced by the fight against discrimination of oppressed groups due to ethnicity, gender, religion etc. (Barnes & Mercer, 2003; Hopkins & Eley, 2001). These stages in history are important to the social construction of blindness and remain relevant in the lives of disabled people today.

2.1.1. Institutionalisation history

In 1980 the World Health Organization, WHO, (1980) provided definitions for the terms 'impairment', 'handicap' and 'disability'. Such definitions have been incorporated in government discourses around the world. These concepts are still subjects of constant debate and redefinition. One critical view on these definitions argues that they remain related to social norms concerning normality and that they are looked upon as something that people suffer from (Hayhoe, 2008; Hollier, 2007). The WHO definitions are:

- Impairment: Any loss or abnormality of psychological, physiological or anatomical structure of function […]
- Disability: Any restriction or lack (resulting from impairment) of ability to perform an activity in the manner or within the range considered normal for a human being […]
- Handicap: A disadvantage for a given individual, resulting from an impairment or disability, that limits or prevents the fulfillment of a role (depending on age, sex, social and cultural factors) for that individual. ("World Health Organization", 1980, p.29)

In the literature comments on these definitions are ambiguous, because in some cases it is difficult to define a disability without considering the social context. Kaplan (2009) illustrates this with the following examples:

- A person who has a cochlear implant;
- A person who has a digestive disorder that requires following a very restrictive diet and following a strict regime of taking medications, and could result in serious illness if such regime is not adhered to;
- A person with serious carpal tunnel syndrome;
- A person who is very short. (Kaplan, 2009)

Such difficulties come from the same WHO definitions, because people can be classified as *handicapped* depending on whether their conditions are classified as disabilities or not, and at the same time such classification depends on cultural settings (Kaplan, 2009).

Barnes and Mercer (2003) are more radical in their criticism, arguing that the WHO definitions address disabilities as medical problems as opposed to social problems. Hence, such definitions are imposed upon people and, consequently, institutionalised under the umbrella of ‘cultural truth’ (Hayhoe, 2008, p.19). Moreover, according to Barnes and Mercer, these institutionalised definitions are a determining factor in society's attitudes towards people with disabilities, especially when these concepts are used in law enactments. As a consequence, this situation would also define normal functions and abnormal functions, limiting the possibilities of disabled people (2003).

We should not diminish the importance of the WHO definitions in times when the absence of an adequate repertoire does not encourage discussions on this subject. With these definitions, the opportunity arises to encourage such discussion. Now, disabled people and their organisations can criticise and make an effort to persuade the WHO to revise its classification in order to correct the strong orientation towards medical diagnoses (Barnes & Mercer, 2003).

The WHO accepted this criticism and proposed a framework to provide a standardised model for measuring and describing health and disability from the individual level and the population level ("World Health Organization", 2009b; Hayhoe, 2008). It was meant to fulfil the lack of a common language and pretended to introduce the given experience of disability as a recognised universal human experience.

To work on this, the International Classification of Functioning, Disability and Health, ICF, (2009b) was officially endorsed on May 2001. One of the improvements was to change the discourse, keeping the medical orientation only to respond to the metrics needed to compare health conditions equally. Other improvements included the inclusion of social aspects of disability in the discourse and the clear separation of the concept of disability as a dysfunction (2009b). The WHO stated:

> Thus disability is a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives. (2009a)

Now the WHO is working on a report that is meant to function as a resource for governments and civil societies, providing updated recommendations ("World Health Organization", 2008a, 2008b). The objectives of the report, which was to be delivery in December 2009 (2008b), are:

> … to document existing information on the status of disability, rehabilitation, and the lived experience of persons with disabilities; demonstrate the gap between what exist and what is required; and issue a call to action with a path forward in an evidence based framework. (2008b, p.1)

For medical measurements the criteria that prevails is the one provided by the WHO, establishing that blindness constitutes an acuity of 3/60 or less (Whitcher, Srinivasan, & Upadhyay, 2001). This metric still lacks standardised criteria, because blindness is by law represented by different values in different countries, and not all countries use visual acuity only to determine when a person is blind. For example, in Great Britain a visual acuity of 1/20 indicates blindness, whereas in the USA the number is 2/20 (Bueno M., 2005; Bueno M. & Ruiz R., 1994; Hayhoe, 2008). Moreover, this is not functionally defined, since this measurement can be biased by external conditions, such as the excess or lack of lighting, the position, backlight etc. For example, the specific ability of an individual to read can be diminished by the quality of the light.

2.1.2. Non-institutionalised definitions of blindness

Other non-institutionalised attempts to classify blindness are more aligned to functional characteristics, like the definitions established by Barraga and Colenbrander (Barraga (1992) and Colenbrander (1977) cited in, Bueno M., 2005):

> Blindness: Lack of vision or only light perception. Impossibility to accomplish visual tasks.
>
> Deep visual impairment: Difficulties to accomplish gross visual tasks. Impossibility to accomplish tasks that require detailed visualization.
>
> Severe visual impairment: It is possible to accomplish visual tasks with imprecision, requiring time adjustments, help and accommodations.

> Moderate visual impairment: It is possible to accomplish visual tasks equivalent to those done by sighted people, using special support and adequate lighting. (Translated by myself from Bueno M., 2005, p.4)

Another classification, more oriented to educational environments, is proposed by Bueno and Ruiz (1994). This classification introduces two categories, focusing on the ability to use printed words, without considering other competences. The first category includes blindness and deep visual impairment from the previous classification. It includes people who can see big fonts or text with the use of supportive static artefacts, but who need to use Braille to read what they write. The second category includes people who can write and read prints, although they require a fixed lens or other specific artefacts to do one or both of these tasks. They belong mainly to the group of people with severe and moderate visual impairments, as described in the previous classification (Bueno M., 2005).

Authors like Lowenfeld (Lowenfeld (1981) cited in Hayhoe, 2008) go further with this classification – which is not necessarily based on the same classification as the one above – but introduce additional characteristic that may influence the behaviour of the individuals concerned. Lowenfeld claims that the age of the individual when the impairment occurs, influences the cognitive and the emotional development, and this may further split the two categories blindness and partial blindness into four classifications. These involve individuals who experience an impairments before and after the age of five, respectively (Lowenfeld (1981) cited in, 2008).

While the age of the occurrence of the impairment is an important factor to consider, it is also vital to consider other factors such as intelligence and social and cultural backgrounds (Hayhoe, 2008). This makes it very complex to work with a holistic classification with relevant factors; and perhaps it is not really necessary. What is more important is that the given model addresses blindness via individuals' 'physical, social and emotional traits' (2008, p.20).

Furthermore, Hayhoe states that the problem is not the classification and the constant changes to the definitions. The problem is not the classification and the implicit discourse of exclusion, the problem ‘is the need to classify in the first place’ (2008, p.114). In other words, institutions should try to find a working model that allows them to perform their tasks without involving classifications that could turn on them.

2.1.3. Discussion on classifications of blindness

The discussion has so far provided a spectrum of definitions, based on different motivations, purposes, functionalities and theoretical and pragmatic orientations, all of which contribute to different goals, but most importantly they contribute to clearer definitions that cover more comprehensive and relevant characteristics of blindness. Discussions, different perspectives and criticisms ensure a better conciliation process and open opportunities for society to move towards more inclusive attitudes.

Following this exploration I would like to consider a series of facts that are important to this research:

The target population that I address in this research is visually impaired tertiary education students without access to printed material.

As they are tertiary education students it is important to take into consideration that they have overcome the obstacles of their educational trajectory, establishing equalised performance, at least in the achievement of the basic goal of entering into the educational institution in question.

I am not considering the evaluation of their individual capabilities, which is not within the scope of this discussion. It is a fact that these students have demonstrated, to themselves and to others, their capabilities to get where they are; and this should therefore not be discussed in the context of this research.

The focus of this research is to identify obstacles of a specific career in the achievement of the established academic goals. This is inspired in particular by the Jernigan statement:

> …the real problem of blindness is not the loss of eyesight but the misunderstanding and misconceptions which exist. It is no longer theory but fact that with reasonable training and opportunity the average blind person can compete on terms of equality with the average sighted person similarly situated. (1994-a)

With these premises in mind I decided to adopt for this research Bueno’s classification (2005). This classification is constituted by two groups, as stated above: blind people who rely on Braille to read and write, and partly sighted people who can read printed material with the use of magnifiers or other supportive tools. I will focus on the first group.

The choice of this simple classification is appropriate for the objective of this research, as it provides a referential frame for identifying our case studies. In addition, I am not interested in other classifications related to measurements, seeing as I address what is required to construct an inclusive environment, considering accessibility and the perspective of the blind. I will draw on the concepts described in the previous definitions regarding the social roles of blindness, thus addressing the social intertwining of blindness and the existence of barriers and avoiding linking them to the mere classification of blindness.

I am interested in the construction of environments where people do not have to worry about whether they are blind or partially sighted or sighted, whether they have an impairment or not or belong to an oppressed group or not; there is always a solution or at least a group that is aware of the individual needs of the students who are not covered by the general solution. This purpose is too broad to be covered in a single study, and such a dispersed focus will probably work against a fair analysis of individuals situations. Hence, I will focus my attention on the world of blind students.

2.1.4. Legal history

When we talk about disabilities, the legal history is relatively short. There are different timelines and implementations in different western countries, but in some way all of them respond to pressures from society.

The more significant event in the legal area, due to its impact on the international community, was the enactment of the U.S. American with Disabilities Act (ADA) in 1990 ("Department of Justice", 2009; Hollier, 2007). This law came to bridge a gap in the United States (USA) legislation with regard to the discrimination of, in this case, people with disabilities. The spirit of the law was to break barriers and provide a legal framework for protecting people with disabilities from any kind of discrimination (Mondak, 2000).

On the other hand, in 1995 England enacted the country's first antidiscrimination legislation ("United Kingdom Parliament", 1995). Such legislation incorporated very few rules favouring students in higher education, and the only one that seems to be of any relevance was a regulation that obliges institutions to provide a statement of details of the provisions they draw on concerning students with disabilities. Unfortunately, things like 'student teaching support, training and social integration, were again ignored' (Hayhoe, 2008, p.113). However, regardless of this lack of regulations and support to higher education students this act functioned as a source of inspiration to many institutions which started to promote disability offices and advisors. This was not enough, though, to guarantee the fair treatment of these students. This guarantee came later with a law called The United Kingdom 2001 Special Educational Needs and Disability Act (SENDA), including important regulations; among other things, it states that universities cannot reject students due to their disabilities (Hopkins & Eley, 2001; Witt & McDermott, 2002).

In another context, the legal process in Costa Rica started in the 1970s with disabled students' enrolment in Universidad de Costa Rica (UCR), a major university in Costa Rica. These students became the basis of a pressure movement, fighting for disabled students' rights at UCR. The fight was related to the irregularity of the services the students needed; these services were supplied by the goodwill of individuals. This situation initiated a dialogue about the necessity of a framework to ensure the resources that students needed to accomplish their studies (Stupp Kupiec, 2005). This process culminated in 1996 with the enactment of law 7600, Ley de Igualdad de Oportunidades para las personas con Discapacidad de Costa Rica (Equal opportunities for people with disabilities of Costa Rica Act) (Costa Rica, 1996) and two years later with Reglamento de la Ley 7600 sobre la Igualdad de Oportunidades para las personas con Discapacidad de Costa Rica (Statutory of the Law 7706 about equally opportunities for people with disabilities of Costa Rica) (Costa Rica, 1998). This law promoted the access of all persons who fulfil the requirements to enrolment in any university, public or private, without discriminating between those with and those without disabilities (1998).

The statutory includes specific regulations for public and private universities, obliging them to provide support offices, technical support, adapted transportation for any academic activity, curricular adjustments, specific formation in disabilities for all career programmes and surveillance of the discriminatory acts (1998).

The case from Denmark is very different from the cases I have mentioned so far, and disabilities is something that has been discussed widely, but until 2004 no single law on the subject was enacted in Denmark (Kallehauge, 2004) (I have not been able to provide evidence of whether or not any laws on the subject have been passed after 2004). The Danish Association of the Blind presents on their webpage the United Nations' Human Rights Convention, adopted in 2006 and ratified by the Danish Parliament on 28 May 2009, entering into force in Denmark on 23 August 2009 ("Dansk Blindesamfund", 2012). The nature of this final implementation depends on each country's interest; the conditions post-ratification are:

> The civil and political rights provided by the convention enter into force immediately when the convention is ratified, while the economic, social and cultural rights will

> have to be implemented progressively, according to the economic strength of a country. (Kallehauge, 2007)

To sum up, even though different countries have adopted different approaches to the treatment of people with disabilities, and laws or policies have been enacted, there is a common tendency in all countries to pursue better conditions for blind people.

2.2. Social construction of disabilities

As we have seen so far, perspectives on blindness have been led and governed by a view of disabilities as a malfunction of body parts. Institutionalisation and legal frameworks represent the responses of society, and more recent perspectives reveal a greater degree of humanistic inspiration; this provides us with the first indication that perceptions of blindness are undoubtedly governed by social and cultural factors (Hayhoe, 2008).

In fact, if we understand that people with disabilities are required to constantly adapt to situations beyond their natural capacities, and these situations are social constructions, then we start to realise that these persons become more ‘disabled by the attitudes that others hold about them and by the environment in which they live and work’ (Clements & Spinks, 2006, p.112; Hollier, 2007).

To illustrate this I would like to use two examples from real situations described by Groce and Sacks ((1988) and (2001) respectively, cited in, Hayhoe, 2008). Both cases concern island populations with a high percentage of people with specific impairments: deafness in one case and colour blindness in the other. In both cases the level of contact with persons with these impairments was so high that such impairments were barely considered disabilities, as many used sign languages and the consequences of the colour blindness were overcome.

Consistent with this view, Goffman states that people with disabilities are used as a way to define the status of others, as a way to consider oneself *normal* at the expense of the *non-normality* of disabled individuals, emphasising the social exclusion of the latter by defining disabilities in terms of appearance, physical characteristics or medical symptoms. This form of definition is what Goffman calls *stigmatisation* ((1990, 1991) cited in, Hayhoe, 2008).

2.2.1. The prejudices

Stigmatisation takes us to the theme of prejudice and stereotyping. The process of stigmatisation is nurtured by *wrong* perceptions of disabilities, and this process is expected to culminate in prejudices. According to Clements et al. (2006), ‘the main roots of prejudice are: ignorance, power, vulnerability, upbringing and conformity’ (2006, p.10). Ignorance is key, because as long as people fail to understand why other people do what they do, there will be a tendency to raise all kinds of speculations; therefore, reducing ignorance is likely to be the more effective way to reduce prejudice. Another root of prejudice is the wish or need to belong to the majority group in order to develop a feeling of power over the people who are excluded from this group. On the other hand, when people feel insecure, they become vulnerable and this vulnerability can at the same time induce prejudices against people with different cultural backgrounds or abilities; it is a way to cope with personal vulnerabilities. Prejudice incurred during childhood is an interesting subject, because it is something that is generated *naturally* during childhood, and it will require deep reflection of individual beliefs and attitudes to evaluate what a given person thinks about people who are different from him or her. The last root of prejudice is the conformity that occurs when people tolerate other people who express prejudices and prefer not to object or take any risks when it comes to going against the mainstream (ibid, 2006).

The other axis presents different manifestations of prejudices, defined by Allport in five levels ((1954), cited in, Clements & Spinks, 2006), starting with the anti-locution, the moderate manifestation of prejudice, consisting of jokes, inappropriate expressions that could ‘denigrate, undermine or draw negative attention to a particular group or individual’ (2006, p.16). The next level of prejudice is avoidance: when the majority group passively supports the exclusion of a minority group. Discrimination follows in a form of prejudice that differs from the previous, because it implies a degree of intentionality, affecting the minority with deliberately actions. The next level comprises physical attacks against persons or property associated with minority groups. The last level on this scale is called extermination: an extreme form of prejudice where the idea is to exterminate the minority group altogether (2006).

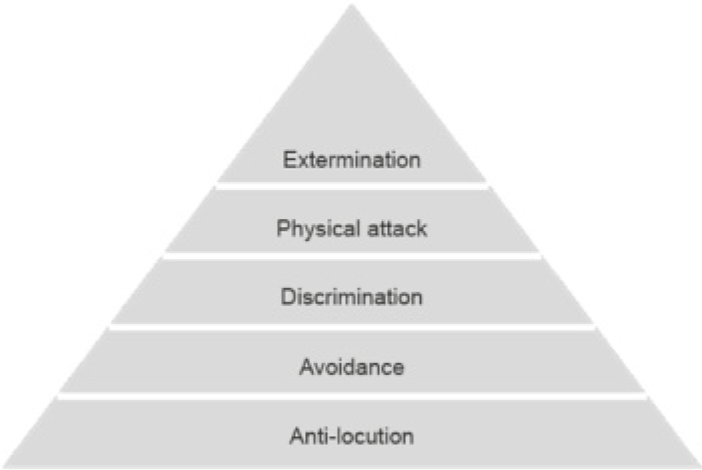


Figure 2.1 Allport's scale which presents the outcomes of prejudice and discrimination. (Clements & Spinks, 2006, p.16)

This research will not directly address the classification of prejudice (but prejudice is considered a source of the social construction perspective), because people normally tend to hide their prejudices and instead try to 'deal with others fairly, without such prejudices influencing their behavior' (Clements & Spinks, 2006, p.10). In this sense, I think it is better to address the classification of prejudice from another dimension that is more open and clear when it comes to identifying social behaviour.

2.2.2. Social construction classification

Most of the literature agrees that the general division is between the medical perspective and the social perspective, what I have called *social* *construction*. This social construction is described as enabling 'the fight against the discrimination', according to Hopkins and Eley (2001, p.2), or more widely by Barton as 'an exploration of issues of power, social justice, citizenship and human rights' ((1996, p.14), cited literally in, Hollier, 2007, p.11). The Connections for Community Leadership (CCL) provides two different definitions: 'disability as a consequence of environmental, social and attitudinal behavior' and 'developed by disabled people in response to the medical model and the impact it has had on their lives' (Connections for Community Leadership, 2009-a).

The fact is that all four definitions move towards a perspective that to a greater extent reflects the social influence on people's disabilities. But there are other more specific classifications. For example, some authors argue that religion or a moral model is the first step in the process of social construction, and even though its prevalence has faded with time it is still possible to observe traces hereof today. In such a model societies view disabilities as God's punishment of individuals or their families, or it is associated with the presence of devils of which people with disabilities are possessed (Clapton & Fitzgerald, 2009; Connections for Community Leadership, 2009-a; Kaplan, 2009).

A model that is less radical, but still based fundamentally on prejudices is the charity model, where people 'suffer' from a disability and are therefore subjected to the pity of others (Connections for Community Leadership, 2009-a; Hollier, 2007).

The other social construction stems from the idea that the medical perspective inspires society. As the medical perspective is interested in the symptoms and manifestations of a given disability, it influences social perception of people with this disability, encouraging society to view blindness, for example, as something that needs to be repaired, thus implying that there is something wrong with blind people. This entails that blind people are subjected to the burden of stigmas. This model is called the medical model, but it should not be confused with the medical perspective (Clapton & Fitzgerald, 2009; Connections for Community

Leadership, 2009-a; Hollier, 2007; Kaplan, 2009; Vargas & Dirckinck-Holmfeld, 2009).

In connection with the medical model, other models have been described, depending on the viewpoints, but still linked to the medical perspective. Models such as Kaplan’s rehabilitation model, and the CCL’s expert/professional model are examples of extensions of the medical model which are linked to the practices of professionals who work with disabilities (Connections for Community Leadership, 2009-a; Kaplan, 2009).

The rights-based model is a response to the inclusion of people with disabilities into mainstream society. However, such inclusion is said to provide adaptations to allow the participation of people with disabilities; still it is a matter of society providing access to these individuals. Also, it was under this model that the protection laws were written, particularly those that are related to discrimination acts and those that work as stimulus to society to take a more active role in the process of inclusion (Clapton & Fitzgerald, 2009; Connections for Community Leadership, 2009-a; Hollier, 2007).

The other model is referred to by the CCL and Hollier as the economic model, emphasising the economic considerations in both directions and considering persons with disabilities a potential part of the economic motor and potential consumers with particular needs (Connections for Community Leadership, 2009-a; Hollier, 2007).

It is important to highlight that all classifications described above do not correspond to any chronologic order and do not refer to steps that must be followed, since such categories respond to a social perception that can change depending on different experiences. Even more so, in some cases they may appear contradictory and/or mixed in one single action, or they may appear in the attitude of persons that work in a support office for the disabled, but who have nevertheless not overcome the charity model in their treatment of the users.

> The social categorisation of disability is the mainstream view of disability during a particular time period within a particular society. This categorisation changes over time, with broader societal changes often providing a catalyst for change in how people with disabilities are perceived. (Hollier, 2007, p.22)

I will use as a reference in this thesis the Hollier classification, as it clearly distinguishes between the models and is descriptive enough to ease their use (2007).

2.2.3. The Hollier classification of social construction

Hollier defined social construction and classified it in four models which I explain briefly: the charity model, the medical model, the rights-based model and the economic model.

2.2.3.1. The charity model

There are significant implications to this model which are interwoven through the perception of individuals with disabilities. Since this model is based on the perception that persons with disabilities have lost certain functions or have experienced a tragedy, it suggests that people with disabilities need help. They are seen as objects of pity, they cannot be independent, and there is not much they can do in the 'normal' world. The main implication of this model is that as the disabled are considered incapable of been self-sufficient, it is necessary to provide all the support they need. If this support is provided, further support is not required. Under such conditions people with disabilities learn 'that freedom and independence is beyond their grasp' (Hollier, 2007, p.23).

This model should also be seen as a metaphor where pity will dominate the interpretation of the disability in question, even though it is not clearly manifested. In fact, there are many situations, attitudes, behaviours that fit with this model, for example, giving over special attention to people with disabilities or changing the tone of one's voice when talking to a person with a disability.

Another consequence of this model is that people with disabilities are seen as objects of charity and goodwill via donations; and this counters the possibility that employers make an effort to offer employment to disabled individuals, limiting their free participation in the social mainstream (Connections for Community Leadership, 2009-a).

2.2.3.2. The medical model

Advances in medical practice has provided better explanations of various impairments, and this has motivated a shift from the charity model to the medical model, seeing as it was now possible to redefine a given disability in terms of the functioning of the body, overcoming strictly emotional definitions.

The first historical implication was that people with disabilities were identified as inferior to the able-bodied; therefore, they were prevented from entering the workforce. Not until a century later were people with disabilities encouraged to enter the workforce (Schlesinger & Whelan, 1979, cited in, Hollier, 2007).

In addition, based on the same principle of incapability, most of the solutions to disabilities were provided without any participation or consultation, mainly by the state, and followed recommendations from the medical perspective or from the expert model. Under these circumstances and due to the notion of protecting *inferior* individuals, governments tend to provide safe environments where, in the name of care, most individual liberties and independencies are limited, ignoring all kinds of rights (Hollier, 2007).

Another implication of this model that still prevails is the labelling of individuals with regard to the degree of normality of the body (Fulcher, 1989, cited in, Hollier, 2007). Such labelling empowers prejudices; for example, employers would consider workers with disabilities persons who were prone to illness and, therefore, to sick leave, persons with reduced performance levels compared to the productivity of their able-bodied colleagues. In general, this model assigns the responsibility for all problems to people with disabilities and frees society hereof. Society's only role is to support disabled persons to develop rehabilitation skills or help them deal with their conditions (Connections for Community Leadership, 2009-a).

I would like to underline that one of the most important exponents of this model is the WHO and its definitions of people with disabilities.

2.2.3.3. The rights-based model

According to Clear, the rights-based model was greatly motivated by the high number of people in the USA with disabilities as a result of the war in Vietnam and the civil rights fight (Clear, 2000, cited in, Hollier, 2007). I might argue that these sources of motivation were shared by most of the western world, as I mentioned in the legal history section above.

The goal of the emergent rights-based movements was the pursuit of equity and independence. This included the rights of people with disabilities not only to be considered able to interact with the rest of society, but also to not be discriminated against because of their disabilities (Hollier, 2007).

This position raised the voice of people with disabilities and established a socio-political discourse that allowed more participation in the political arena and culminated with the promulgation of new legislations (Clapton & Fitzgerald, 2009). This and similar situations provoked the transfer of the responsibility to resolve the difficulties of people with disabilities (Clapton & Fitzgerald, 2009) to society with a view to provide equal opportunities for the able-bodied and people with disabilities (Hollier, 2007).

Still, this model constructs people with disabilities as a minority and maintains the relevance of the concepts of normal and abnormal in the definition hereof, reinforcing the attitude of the 'others' (Clapton & Fitzgerald, 2009). The advantage of this model and the laws is that both share a wish to remove barriers that exist in society, implying that these barriers in fact constitute the main problem. Indeed, if there are any barriers, it is necessary to remove them (Connections for Community Leadership, 2009-a). For example, if an impairment can be counteracted by visual aids and such aids are affordable or freely accessible, it means that this impairment has been overcome. But if the aid is not available in a given context, country, region etc., this impairment becomes a disability to the individual concerned, because it prevents him or her from participating in society with the same opportunities as everyone else. This means that the prevalence of a disability will depend on the development of our societies (Connections for Community Leadership, 2009-b).

The challenge for this model is to determine how the needed adjustments can be made sustainable in the face of increasing numbers of impaired elderly people and how the transition from the charity and medical models to the rights model can be instigated. This could be particularly interesting to observe with reference to professionals in charity and rehabilitation settings (Connections for Community Leadership, 2009-a).

In the educational field, as discussed in the previous sections, laws have included specific regulations concerning the inclusion of students with disabilities into the mainstream of education; therefore, institutions are now required to provide the necessary adjustments to allow all students, without exception, into their classrooms ("United Kingdom Parliament", 2001; Costa Rica, 1998). Nevertheless, there is still work to be done:

> This lack of facilities and support discourages people with disabilities from pursuing their education and reinforces the message that society sees their specific needs as a burden that is either too costly or involves too much effort to meet. (Clements & Spinks, 2006, p.115)

2.2.3.4. The economic model

From the point of view of the rights-based model societies can think that the burden has shifted to them. This is true, but it is also true that this is the only possible way, as societies are responsible for themselves as a whole, and that includes persons with disabilities who are also a part of society. This form of active participation is precisely what defines the economic model.

As discussed, the rights-based model advocates for the inclusion of persons with disabilities into mainstream society and the workforce in particular. Such inclusion can be considered a burden to society, but at the same time this effort will increase the number of consumers in society. These consumers will buy goods and require services, thus affecting the given country’s economy and society favourably (Hollier, 2007). 10 to 20 per cent of the world’s population has one kind of disability or another; therefore, nobody can deny the potential of such a market of regular products and products that are adjusted to individual needs. In this sense, the economic model can be seen as a supplement to the rights-based model, stimulating society to make it more inclusive, to generate a better understanding of people with disabilities and, sooner or later, reducing these disabilities or their effects on people (Hollier, 2007).

2.3. Summary

We have discussed a number of historical facts that define the social construction of blindness as a way to understand how society looks upon people with disabilities, blind people in particular. Such construction is moulded by the social structures that establish the legal frame and the discourses, but at the same time both the legal frame and the discourses are forced to change by improving the perspective of society; that is, this is a two-way process where each is mutually nurtured by the other.

We are going to use the Hollier models in particular to standardise concepts. It is crucial that such models define the social construction of blindness, and such construction can be seen as a tendency that prevails in certain communities, but is not necessarily shared by the whole community. Thus, it is possible to view a specific group using one model; but different individuals may have a different point of view. Also it is possible to link a specific model and a group or an individual, while this group or individual in other situations might fit another model.

Therefore, these four models (the charity model, the medical model, the rights-based model and the economic model) provide a framework for recognising people's responses to disabilities. Such responses can come from individuals or collectives, and they are not necessarily stable, because people's responses can belong to different models in different situations. This means that, in general, people do not belong to a specific model; it is their responses and interpretations that belong to these models.

< CHAPTER THREE >

PERSPECTIVES ON BLINDNESS

> *… the real problem of blindness is not the loss of eyesight but the misunderstanding and misconceptions which exist. It is no longer theory but fact that with reasonable training and opportunity the average blind person can compete on terms of equality with the average sighted person similarly situated. (Jernigan, 1994-a)*

Chapter 3 included a classification of the social construction of blindness to provide models for understanding how society perceives the blind and how such perceptions influence the inclusion process. In this chapter we will discuss different approaches to improving the conditions for blind people. This means that instead of defining social perceptions this chapter will define a new classification that focuses on different ways to support blind people.

In fact, there are different categorisations of perspectives, but the distinction between the medical perspective and the social perspective appeared to be very common. The ICF called the medical model ‘a problem of the person’ and the social model ‘a combination of the charity and rights model where disability was defined as a social problem’ (Hollier, 2007, p.35). I will use as my first classification the medical perspective that is consistent with the ICF’s definition of the medical model. Consequently, I will define three other classifications that are inconsistent with the previous models. These classifications are:

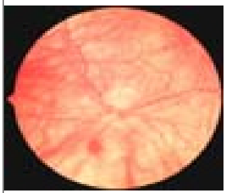
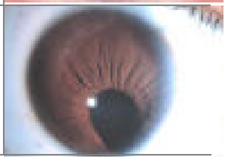
1. The adaptive perspective
2. The integrative perspective
3. The inclusive perspective

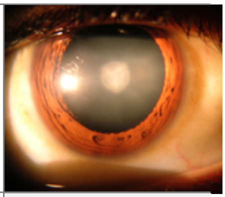
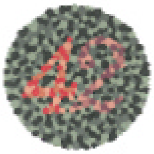
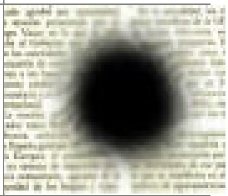
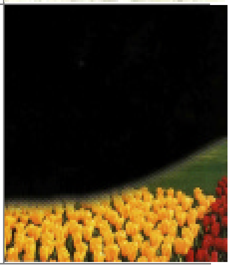
3.1. The medical perspective

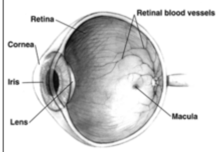
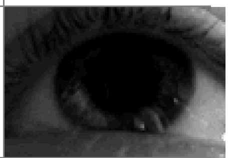
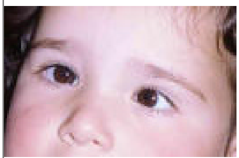
As I have mentioned, the referential measurements suggested by the WHO and the WHA are based only on physical factors. This is one of the expressions of the medical perspective. The fact that these measurements have been widely criticised does not mean that they do not provide information that, used in the proper way, is useful for supporting blind people. The reason for such critique is not that the measurements are incorrect, but that they leave out essential considerations in a more holistic perspective on blindness. This is so because the medical perspective ‘is another framework to view the blindness, and it is related with the scientific developments to improve or recover the lost condition of sight or to understand the alternative ways to cope with the blindness with the other senses or resources’ (Vargas & Dirckinck-Holmfeld, 2009, p.3). Therefore, it is understandable that such definitions meet with such critique, as they were conceptualised from the medical perspective to which precise measurements are required to mend visual anomalies.

3.1.1. Visual anomalies

If we proceed to the roots of the medical perspective, we will find the diseases and conditions that most frequently describe the condition of blindness. Accidents are one of these causes of visual impairments, but the majority of cases of blindness stem from diseases or aging. Symptoms may differ widely, from loss of the central vision to the no side vision, from patchworks in the image to seeing images in a blur, from no perception of light at all to a reduced vision that can be corrected with glasses (About Sight, 2008). Some of these causes are described in the table 3.1.

Anomaly	Description	Illustrations
Keratitis	It is a condition in which the eye's cornea, the front part of the eye, is inflamed. The condition is often marked by moderate to intense pain and usually involves impaired eyesight.	
Corneal dystrophy	Non-inflammatory, inherited, bilateral opacity of the transparent front part of the cornea.	
Keratoconus	Degenerative eye disorder in which structural changes within the cornea make it thinner and change its shape from its normal gradual curve to a conical shape.	
Albinism	Usually individuals with albinism suffer from photophobia, squint, nystagmus and decreased visual acuity. Some individuals will be able to achieve distance acuity levels of only 6/36, but may be able to read by holding printed text close to the face. Appropriate lighting conditions at school or at work are also very important for those with albinism (Webster & Roe, 1998, p.42). Webster, Alec. Children with Visual Impairment : Social Interaction, Language, and Learning in Mainstream	
Aniridia	Underdevelopment of the eye's iris. It is associated with poor retina development at the back of the eye.	
Coloboma	It is a hole in one of the eye structures, such as the lens, eyelid, iris, retina, choroid or optic disc.	

Congenital Cataracts	This form of clouding develops in the eye's crystalline lens or in its envelope, varying in degree from slight to complete opacity, obstructing the passage of light.	
Cataract Surgery for Congenital Aphakia	Aphakia is the absence of the eye's lens due to surgical removal, a perforation wound or ulcer or congenital anomaly.	
Chorioretinitis	It is a choroid inflammation (thin pigmented vascular coat of the eye) and eye retina. It is also known as choroid retinitis.	
Achromatopsia	It refers to an autosomal recessive congenital colour vision disorder, the inability to perceive colour and to achieve satisfactory visual acuity at high light levels (typically exterior daylight).	
Macular Degeneration	It is a medical condition, usually in older adults, which results in a loss of vision in the centre of the visual field (the macula) because of retina damage.	
Retinal detachment	This is a disorder of the eye where the retina peels away from its underlying layer of support tissue. Initial detachment may be localised, but without rapid treatment the entire retina may detach, leading to vision loss and blindness.	

Diabetic Retinopathy	Retinopathy is retina damage caused by complications of diabetes mellitus, which can eventually lead to blindness.	
Retinitis Pigmentosa	This is a type of hereditary retinal dystrophy, a group of inherited disorders in which abnormalities of the photoreceptors (rods and cones) or the retinal pigment epithelium (RPE) of the retina lead to progressive visual loss.	
Optic Atrophy	It is the loss of some or most of the fibres of the optic nerve. This nerve is part of the brain and has no capability for regeneration.	
Glaucoma	This is part of a group of diseases of the optic nerve, involving loss of retinal ganglion cells in a characteristic pattern of optic neuropathy. Raised intraocular pressure causes significant risk of developing glaucoma.	
Nystagmus	This is a form of involuntary eye movement. It is characterised by alternating smooth pursuit in one direction and saccadic movement in the other direction.	
Strabismus	It is a condition in which the eyes are not properly aligned with each other. It typically involves lack of coordination between the extra ocular muscles that prevents the gaze of each eye from reaching the same point in space, and it prevents proper binocular vision, which may adversely affect depth perception.	

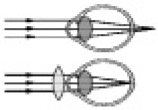
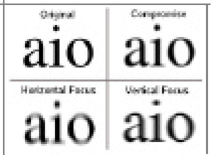
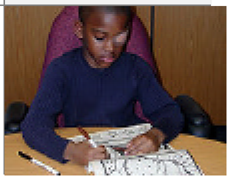
Myopia	This is an eye refractive defect in which collimated light produces image focus in front of the retina when accommodation is relaxed. People with myopia see nearby objects clearly, but distant objects appear blurred.	
Hyperopia	This is a vision defect caused by an imperfection in the eye (often when the eyeball is too short or when the lens is not round enough), causing difficulty focusing on nearby objects and, in extreme cases, causing a sufferer to be unable to focus on objects at any distance.	
Astigmatism	It is an eye refraction error in which there is a difference in degree of refraction in different meridians.	
Presbyopia	It describes the condition where the eye exhibits a progressively diminished ability to focus on nearby objects with age.	
Amblyopia	This is characterised by poor or indistinct vision in an eye that is otherwise physically normal or out of proportion to associated structural abnormalities.	

Table 3.1. List of eye anomalies. (Compiled from Bueno and Ruiz (1994)] and from the American Foundation for the Blind (2009)

My intention with this list was neither to provide exhaustive nor highly detailed descriptions of all possible eye anomalies; my intention was to illustrate the diversity of causes of visual impairments. Also, it is important to take into consideration the occurrence of differences in the intensity of a given anomaly, which will affect the individual sight differently. Furthermore, as evident from the above list the location of an anomaly can both be in the outer or inner parts of the eye, or it can be associated with the brain (Webster & Roe, 1998).

From the medical perspective it is important to cure anomalies which are the results of direct, indirect or congenital diseases, using medicines, treatments, surgeries, transplants, grafts etc. In cases where no cures are available, medical perspective is interested in trying to find a 'solution'. Such solutions could be objects such as a lens, contact lenses, magnifiers, filters etc. or any other object that may substitute sight with alternative forms of perception or replacement of the damaged organ (Gibson, 1979).

Parallel to the description of anomalies and sight conditions and possible cures or adaptations, the medical perspective includes an effort to produce a better understanding of blindness, though, again, focusing on individual facts and not on the effect in a given context. Certainly, many of these understandings do not come from medical practices, but rather from scientific research, from distinct disciplines as well as multidisciplinary.

One of the facts that helps us understand blindness is, for instance, that it is estimated, though it is not supported by a formal research process, that approximately 80 per cent of the information that a sighted person receives is received through the vision (Núñez B., 2001; Villalba S. & Martínez L., 1999). This is probably one reason why sighted people focus their attention on visual stimulus and tend to minimise the information they receive from other sensorial sources. Based on this fact, authors like Lowenfeld, Wills and Foulke (in Núñez, (2001) point to three direct consequences of blindness: 'restrictions on the development of the individual, different and delayed understanding of the world and reduced experiences and relationships with the environment' (Translated from Spanish by myself, 2001, p.5).

Another consideration as regards people who are congenitally blind is that they do not have visual spatial images and are unable to infer spatial concepts. This makes it difficult for them to work with three-dimensional structures and interactive images (Hatwell, Streri, & Gentaz, 2003). It does not mean, however, that blind people are not 'capable of producing pictures which have certain rules of representation in common with the picture production of sighted people' (Kennedy 1993, 2000 cited in, 2003, p.11). It means that it is possible to use graphic support to teach blind students.

Nevertheless, the way that blind people process graphical information or understand the environment is different from the way sighted people do, as the sensorial perception of the former comes from a different source with different characteristics. Senden (1930 cited by Núñez B., 2001) conducted an experiment with blind adults with congenital cataracts and discovered that after surgery that enabled them to see for the first time, they needed to learn to 'see'; they were unable to recognise familiar objects without touching them (2001).

Blind people also have difficulties using an alternative sensorial system to perceive some visual phenomena, like colour, visual perspective, natural phenomena like the movement of animals, things that cannot be reached, like the Sun or the stars, large objects like mountains or small objects like tiny insects (Núñez B., 2001). This kind of difficulty, among others, complicates the processing of different information simultaneously, establishing that the construction of mental images can take longer for blind individuals. This may suggest a limited capacity to process large amounts of information; however, at the same time blind people employ a more complex process for constructing mental representations, contradicting such a conclusion (Hatwell et al., 2003).

Contrasting children's learning processes with and without sight, Scott (1969, cited in Núñez B., 2001) claims that while sighted children become conscious of the surrounding world just by opening their eyes, easing experiences related to the nearby surroundings, blind children need an intentionality to use their hands or any other sense organ to reach mere parts of the environment (2001). This way of interacting with the world is called haptic perception, and even though it has some limitations, it constitutes a relevant method for exploring and learning from the environment.

3.1.2. Haptic perception

There are differences between touching, hearing and seeing. One obvious difference is that touching requires proximity, because the receptors for the stimulus are distributed across the body. This creates limits in the scope of tactile perception, some of which have been discussed above. In fact, such limits are determined by the zone of contact with a given object. Contact consists of two different phases that generally function together. The first phase involves tactile perception when the stimulus is present in the part of the body that is working as a receptor. The field of perception is limited to the surface of the skin in this area, making it possible to discriminate the object (Katz 1925/1989; Gibson 1962, 1966; Revesz 1950 cited in, Hatwell et al., 2003). The second phase occurs if object recognition in this context requires exploratory movements. The scope of the field depends on the body part in use, most often a single finger, a hand or both hands, moving the wrist or the whole arm. Haptic perception is the conjunction of both phases, resulting in their integration in a single construction that represents the object in question (Revesz 1950 cited in, 2003) (Núñez B., 2001).

This process suggests that haptic perception is very sequential, at least when it is compared to vision. However, it is necessary to take into consideration that vision, even though it is more holistic, relies on the movements of the eye and the head to explore spatial properties of the environment. The difference is the speed of this exploration that is usually considered insignificant when it is done with the eyes. On the other hand, haptic perception is not as sequential as audition. In fact, due to the temporality of the stimuli and the structure of the message that is carried in the audible stimuli, the order of the sequence cannot be changed. In contrast, haptic perception, even though it requires the movements of the body parts to be ordered into a sequence, these movements are not present and it is possible to explore the same area of the object repeatedly (Hatwell et al., 2003).

The advantage of haptic perception is that it explores material properties of objects, particularly texture and temperature, and it is sensible to use different material properties to ease object identification. Thus, it seems that, as mentioned above, information from vision and information from touch are not the same; rather, they should be redundant and, in some cases, cooperative. Reading a map, for example, is a difficult task for a blind person, because the ‘touch is not very adapted to two-dimensional material’ (Hatwell et al., 2003, p.257). This procedure also requires adaptation from a bidimensional representation to a non-perceptible space, and even with a simplified map it is not a natural task, neither for the blind nor the sighted, and it requires training to learn to do it (2003). In this case, it is equally important to have the right skills and previous knowledge of the context presented by the map. This was demonstrated in an experiment that concerned the recognition of geometric shapes and involved three groups of adults: persons who were congenitally blind, persons who had become blind late in life and sighted persons who had been blindfolded. The group of persons who has become blind late in life had a clear advantage over the other groups, because of their previous visual experiences and their training in tactile modality (2003).

The importance of this result is that these difficulties of persons who had become blind early in life in interpreting drawings made them react against the use of graphical representation, even though they, from a pedagogical point of view, can be beneficial; this is so probably because the effort put into interpreting and understanding them can promote intense cognitive work (Hatwell et al., 2003).

The maximum referent of the relation between haptic perception and blindness, used predominantly though not exclusively in the academic world, is probably the Braille alphabet, allowing blind people to read from paper on which each letter is represented by six or eight dots embossed into the paper.

3.1.3. The boundary between the medical and adaptive perspectives

In general education has been based on all kinds of visual support, and due to the relatively recent explosion in new technologies, there is an even higher dependency on visual interfaces. This causes various difficulties, especially for people who were born blind (Murray & Armstrong, 2004 cited in, Hollier, 2007). To overcome these difficulties it is necessary to provide alternative materials that focus on drawing on the strengths of blind students, that is, tactile and auditory means of learning. Therefore, Webster and Roe claim that for these students a curriculum should include ‘socio-linguistic interaction and conceptual development, mobility and personal independence, use of information technology and Braille’ (1998, p.9).

It is also important that blind students come to understand how they learn in order to assume an active role in their own learning processes; this will help them identify the best ways for them to understand and learn, that is, develop self-awareness of their own learning and enquiry. But the most important aim is to focus on what they can do, not on what they are unable to do (Webster & Roe, 1998).

For instance, the use of metaphors and analogies is usually avoided by teachers, as these can entail representations that are inaccessible to blind students. The consequence of these practices is that students will distance themselves from the real and functional environment. This does not mean that students should be forced to understand these representations, but they should learn the concepts behind these representations in order to enrich their cultural knowledge (Vanbelle 1982, cited in, Hatwell et al., 2003).

In connection with the use of technology in classrooms, students also use technology to support their individual learning. One of the main forms of support that students draw on is the opportunity provided by the computer to listen to all written material rather than read it in Braille. But this may entail negative consequences, because as a result some abilities can be lost, such as the ability to read Braille speedily and efficiently, orthography skills and, moreover, knowledge of new words, which students will subsequently be unable to spell (Maciel de Balbinder, 1999).

In essence, this medical perspective corresponds to the study of the phenomenon, but it stays neutral in relation to the social. In some areas it would be difficult to separate these two perspectives due to the interrelation between the phenomenon and the social, but we should consider this an epistemological difference.

3.2. The adaptive perspective

This new perspective is closely related to the medical perspective; its motivation is also to find solutions for specific situations that blind people are faced with in their daily lives. What distinguishes this perspective from the medical perspective is the interweaving of the social and the scientific. The adaptive perspective is interested in solving specific limitations in individuals' interaction with society, approaching adaptation as something that belongs exclusively to the blind person, who nevertheless remains integrated into society as a whole. The best exponent of this perspective is likely to have existed before societies began to think about the rights of the disabled. The white cane, for example, is not only a tool that blind people use to gain mobility; it also works as a user identification to support blind people's interaction with their surroundings. Canes have been used for centuries as a mobility tool, but it was not until James Biggs in 1921 painted a cane white to make it more visible and support the mobility, enabling its blind user to interact with the surrounding world, beyond the range of the habitual cane ("White Cane", 2009; Hollier, 2007; Strong, 2009).

If we review this concept closely, we come to understand that the innovative aspect of this perspective is that it is related to how the surrounding world recognises blindness by way of distinct tools. Ever since human beings started to produce tools, they have had ideas for their further development. Tools were meant to solve problems and their interaction with the social was in-built. Such tools worked as extensions of the human body, and without tools the dispossessed became disabled. Therefore, this adaptive perspective of blindness is included under the umbrella of adaptive technologies (AT) in the broad sense, which in their design strive for permanent accessibility. Hollier separates this concept of adaptive technology from assistive technology on the basis only of the temporality of the latter; assistive technology is based on adjustments to existing technology. This does not mean that it is not possible to talk about AT in connection with existing products, but it would require making adaptations to products in order to achieve permanent accessibility (2007).

Moreover, King (1999, cited in, 2007) has argued that a successful AT product design is a design that makes the product easy to use effectively without training: what he calls transparency. However, transparency is not the only criterion for success in AT developments. Like any other product, AT products need to fulfil the expectations of the potential clients and consultation is indispensable; this is especially important when we do not fully understand the reality of the users. This was the case in the niche discovered after the end of World War II: the use of ultrasonic signals as a mobility aid. The idea was clear, and it generated expectations in the target clients who expected it to ease their mobility and provide them with a greater degree of independence. Some laboratories produced prototypes that were successful from the point of view of the producers and their original list of goals; however, hurrying to introduce the product in the market, the producers forgot to ask the users what they thought of it, which ultimately meant that the product was never delivered commercially (Hollier, 2007). Consequently, seven main requirements were defined to meet the needs of the users:

- Simple to use
- easy to interpret mobility information
- discreteness of mobility device
- public understanding of mobility device
- detection of objects within a normal visual range (approximately 180 degrees)
- assist in crowded places and
- does not interfere with other senses. (Hollier, 2007, p.62,63)

Some of the drawbacks that have made different products unacceptable to blind users are: the aid does not detect obstacles at the floor level or overhead objects; the audible output is an unacceptable distraction to the user; they are not discrete enough, attracting the attention of the public; the audible interfaces are so complicated that using them would require much training (Hollier, 2007).

Thus, user consultation is an important part of a successful AT design, and some authors go even further. On the subject of the design of e-learning tools authors suggest that not only disabled students should be involved, but also ‘people who are knowledgeable about the needs and concerns of students with disabilities’ (Conroy 2002; Middling & Bostock, 2002; Phipps, 2002, cited in, Seale, 2004, p.54) and ‘the use of “non-traditional facilitators” such as a disability officer for workshops in this field’ (Phipps (2002), cited in, Seale, 2004, p.54).

The above is an example of what learning technologists may take into consideration in the design of e-learning products. Regarding the factors that influence the practices of UK learning technologists on the subject of accessibility, Seale (2004) conducted a literature review to determine what practitioners and researchers had discovered in their studies of learning technologists and what the latter take into consideration in their work:

- the difficulties of responding to SENDA1;
- the identification and implementation of existing accessibility tools and guidelines in order to comply with SENDA;
- the adaptation or re-framing of generic accessibility tools and guidelines for more specific practice(s);
- a call to involve disabled people or their advocates in the design of electronic material. (Seale, 2004, p.52)

Other relevant information is the impact that SENDA has provoked in educational institutions, especially in universities that are now forced to create structures with the participation of disability services, staff development teams and departments in order to develop joint programmes

[1] SENDA is a UK law (Special Educational Needs and Disability Act).

(Middling and Bostock (2002), cited in, Seale, 2004). In this sense, SENDA fulfils the spirit of the law, forcing society to establish equal opportunities for all. Consequently, schools and universities should not only work to prepare the environment, but to prepare the future professionals whose task it is to incorporate such accessible practices, that is, IT students in particular, who will be key actors in the creation of future products (Trajkovski, 2006).

So far I have discussed the development of tools that are directly oriented to solving problems of interaction between blind people and their surroundings. Furthermore, I have highlighted the importance of the participation of different actors in such developments. The next level we need to consider is the design of conceptual tools ‘such as metaphors, models, frameworks and theories’ (Seale, 2006, p.4) that allow us to have a better understanding of current accessibility practices and how we can improve them, taking into account what I have discussed above: the people involved, the relations between them, the context of people and social interaction (2006). In fact, part of this research is concerned precisely with these considerations.

3.3. From the adaptive perspective to integration

The adaptive perspective is an important component in the achievement of inclusion; but it is not enough. This perspective establishes the basis for the next stage in the process of inclusion, because if a person with a visual impairment is unable to improve his or her mobility, achieve independence, access information, produce the same as people who do not have a visual impairment or interact without restraints with the environment, then he or she is unable to effectively integrate into society. With ATs blind people are able to share spaces and places, they are able to experience much the same as able-bodied people, they can enjoy and suffer in similar ways, but without ATs they cannot fully integrate.

3.3.1. Obstacles to the integrative perspective

So what makes the difference? While the adaptive perspective focuses on inclusion by adaptation, the integrative perspective would argue that the environment must be prepared to meet the needs of both blind and sighted people; the difference is that this is not only done through the provisioning of tools, making the blind adapt to the context. Instead, integration would attempt to break down the barriers that still exist, the ones that are not reachable to blind people, because to break them down requires the participation of the rest of the community. This is not only true for blind people, but for any person from a minority group or a group that, although it is not a minority, acts as a minority under the control of the dominant group (Clements & Spinks, 2006).

Universities are not exempt from this phenomenon, and according to Rebick (2001) there are several reasons why universities contrarily tend to be more reactive to change. One reason, which is not exclusive to universities, is that the dominant group is not naturally motivated to change situations that affect minorities.

> When you are in the dominant group, when things are good for you, when things feel comfortable for you, you just assume that it is good for everyone. I don't know why it is so hard to understand that someone else's reality can be different from your reality. (2001, p.59)

According to Rebick, another reason, and this reason is particular to universities, concerns *academic freedom*, and the incorrect interpretation that such freedom entitles academics to do whatever they want in the classroom, to make adjustments even if it means that people will not receive equal treatment. It is noticeable that these issues are related to marginalisation, not discrimination, which makes it difficult to canalise it through legal frameworks (2001). Some cases may be related to prejudices, as discussed in chapter 3, and are likely to be based on ignorance; nevertheless, such cases need to be corrected.

This is where artefacts like SENDA can provide the *stimulus* for academia to overcome the limits and introduce equal opportunities for everyone.

Moreover, we should not deny the pressure that such an artefact provokes in the academic environment; it became a coercive tool through excessive auto-surveillance of the observance of the law as not all the demands for equality were satisfied (Seale, 2003-a). And we should not forget that it is not possible to consider every single detail in an academic environment, affecting institutional practices and achieving full participation of stakeholders in such practices (Witt & McDermott, 2002).

3.3.2. Moving forward for the integrative perspective

Indeed, designs should not focus on defining a practice for blind people; this practice must be considered as part of the design itself, including the needs of all groups, particularly blind students via what Scott et al. (2003) call an ‘integrative approach’. This is the foundation for the concept of Universal Design (UD), coined by Ronald Mace in the early 1970s (Scott et al., 2003). It is used by architects and designers as a way to establish comprehensive plans to satisfy the aesthetic needs of all the individuals who use the designed spaces (Silver, Bourke, & Strehorn, 1998). Then the concept evolved and became Universal Instructional Design (UID) (Silver, Broke, & Strehorn, (1998), arguing that barriers should be eliminated from the design phases which should focus on as many people as possible, rather than individual adaptations (Rose, Harbour, Johnston, Daley, & Abarbanell, 2008; Scott et al., 2003). The natural consequence of UD is to see inclusion as an attempt to proactively ensure the inclusion of all students, instead of adopting a reactive or legalistic approach (Burgstahler, 2008-b; Scott et al., 2003). Scott et al. underline two main assumptions. Firstly, Universal Design never has to compromise academic standards or the expectations to the instruction concerned, but seeks to teach all students effectively. Secondly, one design that fits most students is preferable to working with multiple distinct solutions, because a single solution would address the instruction of a multiplicity of students whereas an instruction with exceptions could compromise the consistency of academic standards (Scott et al., 2003).

Therefore, the relevance of UID is that as the instruction is designed in advance students with special needs do not need to identify themselves as disabled in order to receive specific accommodations, adjustments or assessment procedures, and they do not have to wait for them for a long time, easing students' integration into the normal educational flow. At the same time, such a design would also be beneficial to the rest of the students (Silver et al., 1998).

The research of Silver, Bourke and Strehorn contain a number of conclusions by faculty members on the subject of UID:

- It required a change or transformation in the instruction in the university community and culture.
- The faculty was passive, offering suggestions for ways to achieve such transformation, and it was sceptical about its feasibility.
- This was consistent with previous studies that had established that higher education faculties are conservative in their educational goals and reactionary to changes. This is reflected in the findings from the study: the educational goals are mainly the same as they were 20 years before.
- The fact that the faculty considers time of great value causes limitations in the starting phases which become highly time-consuming.
- They accepted that the faculty can become aware of special students' needs and the adaptations required.
- The faculty assumes the responsibility for providing these adaptations.
- Most teachers are experts in their academic field, not teachers with pedagogical knowledge.
- They do not feel prepared to distinguish between different learning needs.
- There is a conflict between the interpretation of teachers' teaching freedom and the enforcement of instructional techniques. (Silver et al., 1998)

In fact, the above conclusions show the difficulties in implementing an integrative perspective. This change must have an impact on a reactionary group of people in different vertexes who require economic, political and technical support (Booth & Ainscow, 2002; Silver et al., 1998). A list of UDI principles has been formulated by the North Carolina State University to guide universities endeavours' to try to further improve the conditions for students with disabilities; this will be discussed later in section 4.3.4.

3.4. The concept of inclusion – the perspective

An example of UD is the curricular adaptation of the time allotted to a test; extra time is usually provided to some disabled students. According to Higbee (2008), rather than making explicit the need for adaptation in specific cases, it is better to extent the time given to all students. Such a disposition eliminates the segregation effect that is implicit when you need to isolate students with special needs, and it ensures that potential invisible disabilities do not become common knowledge (2008). In this sense, extra time to complete a test could belong to a different perspective, depending on the way it is done. If the extra time is assigned only to blind students, it would come within the adaptive perspective, as this extra time is used as a way to solve a problem. However, this adjustment could come within the integrative perspective when it is designed to meet a specific student's needs, but, at the same time, is applied to all students. Finally, if such an adjustment is designed regardless of whether the group in question includes students with special needs then it is an answer to the inclusive perspective.

The Alliance for Inclusive Education produced a division of terms along the same line. Firstly, they defined *segregation* as instances in which children are placed in special schools; this tends to give them a life that is separate from the rest of society. The second classification is *integration* which is when children are moved into the mainstream with other children, using adaptations and resources to make these children adapt to the existing environment. Finally, the third classification is *inclusion* which happens when solutions that fit most children are provided in the mainstream and the educational environment is committed to ensuring the full participation of every child, disabled or not disabled ("The Alliance For Inclusive Education", 2009).

Another example is that e-learning is considered a good resource for blind students, as ‘it can provide an opportunity for people to share with others and obtain a vital support mechanism’ (Hollier, 2007, p.53). It works as a communication barrier breaker, because people experience fear and ignorance in social interaction with blind people, and the disability is hidden by the communication media, providing inclusion into the mainstream ((Price & Shildrick, 2002) cited in Hollier, 2007). The next concern is accessibility matters, as ‘there is a lack of scrutiny and criticality regarding the accessibility research and practice that is currently disseminated’ (Seale, 2006, p.5), and little literature exists on accessibility via e-learning (Seale, 2004; Witt & McDermott, 2002).

In the above scenario we recognise the adaptive perspective when people show an interest in using e-learning as a tool for blind students. It can also be said to reflect the integrative perspective when such a tool allows the blind student to interact in the mainstream like any other student, without the burdens of his or her disabilities; nevertheless, this does entail that the student adapts to established practices. A complete inclusive perspective relies on design thinking that takes the greater possible diversity into account.

Another consideration is that the inclusive perspective will not find in e-learning an alternative to blind students. The inclusive perspective will try to make the e-learning programmes inclusive, useful to any student who wants to make use of it.

Booth and Ainscow (2002) state that educational designs should gradually improve the degree of inclusion, and they need to include three dimensions for this to happen:

1. Producing inclusive policies
2. Evolving inclusive practices
3. Creating inclusive cultures (Booth & Ainscow, 2002, p.7)

In this respect, Booth and Ainscow emphasise the relevance of creating inclusive cultures in two directions. The first is acknowledging the lack of attention that has been given to cultural facts in support of inclusion, and the second is that they are convinced that ‘the development of shared inclusive values and collaborative relationships may lead to changes in the other dimensions’ (Booth & Ainscow, 2002, p.8).

Therefore, we may say that if UD is seen as a tool for designing products for the blind, the relevant perspective is the integrative perspective; however, if UD is seen as a philosophy, it represents the inclusive perspective. The difference is probably the number of times the educational environments repeat the production of these designs and the scope of such designs, considering the three dimensions defined by Booth and Ainscow: producing inclusive policies, evolving inclusive practices and creating inclusive cultures.

3.5. Summary

Now we have defined blindness from the point of view of social construction, discussed in a previous chapter, and the different approaches to working with blindness. The relevance of this second classification is to identify the expected results of each inclusion initiative. It was argued that all four perspectives, the medical perspective, the adaptive perspective, the integrative perspective and the inclusive perspective are usually required in different parts of the inclusion process. In the following chapters we are going to use this classification to determine the initiatives that have been implemented or proposed to orient the state of the art in educational environments and to guide educational institutions that plan to launch an inclusion process or to orient their efforts according to the basis of the process. This is a fundamental step in understanding blindness and the process of inclusion.

< CHAPTER FOUR >

TOOLS

> *…precisely all of these things, like a especial table, a blackboard, a door that opens to both sides, a especial pencil, are details that always are appreciated… and I think this is the goal of this workshop, to explore the technology. But when we talk about technology, we always think of computers, Internet and virtual things. And absolutely all of this is high end technology, but I like to part from the root of technology, for example a holder for a fork is also technology, as well as basic elements that aid in the studies. From small things as the shape of a table, the color of a light until high end technology, the simple fact of the way a teacher communicates it is also technological, technology is within the language. [Ernesto, Costa Rican Student, 348Y]*

In this chapter I will present the results of a literature review on the subject of tools for blind people. Furthermore, an Internet review was conducted to compile a list of products offered in the market, supplemented with a general literature review of tools that have been developed for specific uses, focusing especially on tools that support academic requirements.

The aim of this chapter is not only to inform about the state of the art, but also to broaden our understanding of blindness and the way people overcome their difficulties by using existing tools. Therefore, I have made a selection of representative tools for each section of this chapter, thus trying to give a more detailed overview of the tools used by blind people and the tools that have been developed in the market. This could be helpful for discovering that some basic everyday elements and tasks require special efforts or particular tools to be carried out or to improve efficient use. At the same time, this selection describes situations that can be considered difficult or impossible to overcome and ways in which blind people handle and finally manage to overcome them. In addition, it will provide inspiration for possible solutions based on existing tools or on the research of others.

In general, tools provide functionalities that are either unnatural to the users or which the users need to improve for them to be able to perform specific tasks (Hollier, 2007). This is equally true for blind individuals who rely on specially designed tools or existing tools that have been adapted to support functions that their own bodies are unable to perform. Therefore, there is a great variety of tools that have different impacts on the lives of these individuals and different levels of complexity. Some tools can be ignored, others become essential after their incorporation. In this chapter I will provide an exploratory review of tools used by blind people; in some cases it will also describe how the tools developed. I intend to provide the readers with insight into some of the existing tools in order to improve their view and understanding of the needs of blind people and how tools can act as extensions of the body.

I would like to use two specific tools as sources of inspiration for this chapter, both of which have a long history and are related to mobility and the accessibility to written material, respectively. These tools are the cane and embossed characters. As I have mentioned in a previous chapter, the cane has been used for centuries to improve the mobility of people in general, and embossed characters have allowed blind people to share knowledge and ideas in written form. These two tools are the precursors of the freedom of mobility and written communication, and they have developed as far as technology has been able to support them. In recent times the emergence of perspectives towards inclusion and the social construction of disabilities turning to the economic model have been combined with technology to promote the development of more and better tools. In this sense, the first two sections of this chapter are dedicated to illustrating these evolutions, and I will conclude each section with a brief discussion of how this evolution relates to the perspectives and the social construction of blindness.

In the third section I will emphasise the educational context and, in particular, areas related to computer sciences, problems that have been clearly identified by other researchers, the solutions that people use in academia to overcome various difficulties and the tools that are in the process of being developed. Diverse kinds of tools are reviewed: from materials for producing alternative forms of information to software and hardware that make information available in oral form; from special machines to international guidelines; from pedagogical guides to strategies for providing inclusive environments.

In the last section I have included a list of different products offered in the market. In the list are products for school, for leisure, for everyday life and for the kitchen, just to highlight a few everyday areas in which tools can help and from which we can come to understand which difficulties blind people may be faced with. Most of these do not require detailed descriptions; they are self-explanatory.

4.1. Written communication

The history of writing is long, starting around 4,000 BC as a way to keep track of complex trades ("Writing", 2009). Since then the scope of writing has increased, and its relevance does not require discussion, but it was not until the end of the 18th century that the writing and reading of blind people were introduced. Valentin Haüy discovered that blind people were able to recognise patterns through touch when he in 1784 gave a boy who was begging outside a church a coin and the boy was able to identify the denomination of the coin (Kimbrough, 2009). Based on this revolutionary insight Haüy developed an embossed system that consisted of raising the shapes of letters on wet paper and then gluing another sheet of paper onto the reverse side to provide more resistance (See Figure 4.1). This system not only took a long time to read and was difficult to write; the weight of the books and the space consumed also had to be taken into consideration (2009).

Figure 4.1. Valentin Haüy’s embossed print letters. (Kimbrough, 2009)

4.1.1. Braille

It was in October 1824, at the age of 15, that Louis Braille created a code based on six-dot cells, inspired by his own experience as a blind student and the Barbier military model. This code allowed the representation of 63 different characters, and after some adjustments to the first version the system began to be used enthusiastically by Louis’s peers in the Royal Institute for Blind Youth, an institution established by Haüy where Louis was enrolled. Even though their partners recognised the advantages of the system over the previous embossed letter system, the Braille system was not officially accepted in the school until 1854, after overcoming political interference, and it was not recognised worldwide as an essential tool for the visually impaired until years later. The main advantage of the Braille system was that it could be written manually, which was almost impossible with the embossed letter system (Jernigan, 1994-c; Kimbrough, 2009; Organizacion Nacional de Ciegos Españoles, 2009).

However, some cases still require the use of embossed letters. Gill (1999) states that even though the Braille system is used most extensively by the part of the world’s population whose vision is insufficient for reading, in the UK less than 10 per cent of this population is able to use Braille. Elderly people make up the majority of the 90 per cent who do not use Braille (1999). This fact is not unimportant; elderly people do not use Braille for two main reasons: they are less motivated to learn a new reading system, because they do not think they really need it; and their ability to develop the sense of touch is more limited than in children, in some cases it is not possible at all, especially if it is combined with other elderly conditions (Bonet B., 2004; Gill, 1999). In these particular cases and in others cases with people who do not master Braille due to innate inability or for medical reasons, using embossed letters could be useful, seeing as it is easier to learn and less tactual sensitivity is required. The disadvantages with respect of a person who can master Braille are that it takes more time to read, it takes up to four times as much space and, as mentioned above, it is almost impossible to write manually (Gill, 1999).

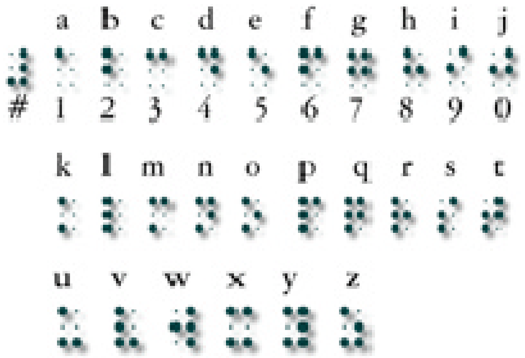


Figure 4.2. The Braille alphabet. (Jernigan, 1994-c)

Figure 4.2 shows the basic set of characters of the Braille alphabet. Notice that there are no capital letters and that the numeric digits use the same point combinations as the first 10 letters from a to j. A special symbol preceding the number is used to differentiate it from the letter, and symbols preceding a letter indicate that such a letter is a capital letter. In the same way a combination of two symbols provides a wider variety of representations, extending the limit beyond the 63 different symbols. Another modern variation of the original code was the inclusion of contractions (i.e. 'ab' for 'about' or 'rcv' for 'receive') and symbols that represent sequences of characters (i.e. symbols for writing 'th' or 'time' or the word ending 'tion') to improve the speed of the reading. Variations went even further, with special codes for mathematical and scientific symbols called the Nemeth Braille Code and codes for representing music. In the case of the Computer Braille Code, eight points instead of the original six are required to represent the set of characters in the computer with a one-to-one correspondence to ensure the proper representation of programmes and other particularities in computers ("Free", 2009; Cierco, 2002; Jernigan, 1994-c). The consequence of some of these variations is that they have entailed a loss of code standardisation, especially with regard to codes for contractions or sequences of characters which are very language dependent (Bonet B., 2004). For instance, Spanish has no contractions, but other language symbols such as accent marks for vowels and the letter ñ ("Foreign Language Braille", 2009).

4.1.1.1. Manual devices for Braille

Initially, a slate and a stylus were used to emboss the points into the thick paper, and this system is still used for manual writing (notice the need to emboss the points using mirror writing, as the points need to be pushed out from the back of the paper). The slate is a hinged device with several cells with six slots each in the upper part and indentions in the lower part to allow the embossing of the paper (see figure 4.3). There are many different kinds of slates and styluses which meet different needs and preferences; the material they are made of varies, as does the size, the number of cells per line, the number of lines, and there are particular designs for specific uses.

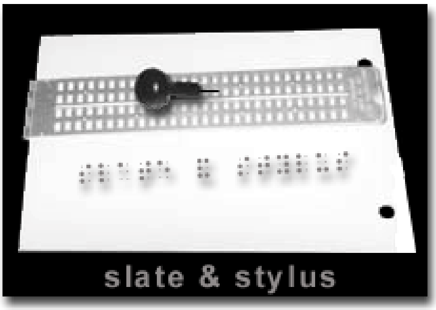


Figure 4.3. Example of a slate and stylus. (Jernigan, 1994-

4.1.1.2. Machines for Braille

Then a kind of typewriter was produced; it had a keyboard which is known as the Braille keyboard with only six keys that could be pressed simultaneously, depending on the points, and a space bar, and it could work with thick paper (see figure 4.4). It is commonly called the Perkins machine and there are different models for different spacing between dots, thus accommodating various reading abilities. Some Perkins machines are strictly mechanical, whereas others are electric, making it easier to press the keys. This kind of machine is characterised by being heavy-duty and noisy when operated (Jernigan, 1994-c; Núñez B., 2001).

Figure 4.4 Braille embosser or typewriter. (Jernigan, 1994-c)

With the advent of computers other tools have been developed as a supplement to Braille, and in some cases with the result that Braille has been pushed backwards, stressing the supremacy of computers' reading function. The list of complementary tools includes a variety of embossers that can be connected to a computer to produce Braille documents. Embossers do not only vary in brands, but in functionalities as well, from the simplest machines that have only one side, are slow to use and have a high noise level to two-side embossers with simultaneous printing, high speed and little noise. Prices vary from 1.800.00 to more than 90.000.00 dollars ("Expanding possibilities", 2009; "Free", 2009; Bonet B., 2004). I should highlight the functionality of some printers that can emboss and ink print the text, making it possible for both types of readers, the visually impaired and the sighted, to read the same document.

Other embossers have special functions; for example, they can produce labels that can be used to identify different products. In some cases, labelling products is a useful way to avoid uncomfortable situations like opening a can of beans expecting tomatoes or wearing the blue pants instead of the brown ones. In other cases such identification could be essential for people’s safety; just think of the ability to distinguish between different medicines and between a can of insecticide and a can of cocking oil (Bonet B., 2004; Gill, 2005). The European Commission has issued the Guidance 2004/27/EC as regards the labelling of medicines with Braille. This guidance also requests that patient information leaflets are made available in different formats, but it fails to specify what is meant by alternative formats, and, therefore, Braille is often omitted from these alternatives (Gill, 2005).

Labels are also useful for organising study material such as printed copies, books, CDs, cassettes etc. When material is organised into files, labels make it easier to access the information stored there. Also, it is important to label documents separately in case someone drops a file and the contents subsequently need to be reorganised (Child, 2003).

There are other ways to generate labels, for example the Braille Dymo Labeler: a manual machine that, instead of embossing letters, embosses Braille. Special labels are available for different kinds of embossing, and some labels already come labelled. Some of the uses include the labelling of clothing, jewellery, groceries like bottles, cans, boxes and frozen food, appliances with knobs, buttons or flat panels that make it difficult to distinguish between the position and direction ("About RNIB", 2009).

4.1.1.3. From mechanics to electronics

As mentioned, another artefact was the typewriter or Perkins machine. Initially it was also used as a tool for taking notes in class, although it was inconveniently noisy and tended to disturb the rest of the class, and it generated extra paper that made it difficult to administrate and even to transport. Later this piece of equipment evolved into electronic devices, still fitted with the Braille keyboard, but with different functions. Instead of embossing characters into paper, it stores information electronically, has a basic word processor and is usually supported by built-in speech software for retrieving information. Additional functionalities include calendars, clocks, calculators, voice recorders etc.

Figure 4.5. Note taker with Braille keypad and voice recording

Most of these devices can in different ways be connected to a computer, making it possible to transfer files edited with the use of the device in question to a computer. If required, it is possible to generate Braille paper directly via an embosser ‘printer’ or a computer with the proper software (Child, 2003).

More expensive models also have a Braille line or refreshable Braille output, that is, a set of cells that raise dots electronically, depending on the text reproduced by the device. These keypads are very useful, as they provide a complementary source in Braille of the text that the users read using a speech synthesiser, for instance if the text contains foreign names or words or web or email addresses; the latter would be difficult to understand or recognise unless the user is able to read them character by character (Bonet B., 2004; Child, 2003; Denham, 2003). Some Braille lines are available as extensions to a regular computer keyboard, allowing easy access to the Braille line (Bonet B., 2004).

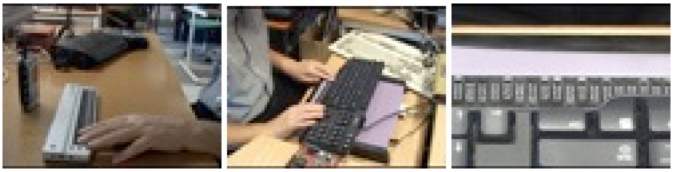


Figure 4.6. Braille keypads.

4.1.2. Reading by listening

In the absence of sight, people use haptic and hearing abilities to compensate for their handicap, and reading is not an exception. I have discussed reading with the use of the fingers, and as hearing is another sensory mechanism it seems obvious that it can be used as another means for executing a function similar to that of reading with the eyes. In contrast to haptic reading, in reading by listening technology has played a fundamental role, culminating with the implementation in computers.

4.1.2.1. Screen readers

Information in electronic format suggested the possibility of using a desktop or laptop to store information and extend the functionality to other applications of general use. In fact, such a suggestion was made possible with the use of computer programmes called *screen readers*. Basically, the function of this software is to read aloud the text that is present in the active screen window (Bonet B., 2004; Child, 2003). Such reading is made possible via the use of speech synthesisers that convert text into spoken words based on phonetic and grammatical rules. Such rules are governed by the language, enabling the programme to produce the correct, corresponding pronunciation. Voice quality, speed of conversion and available languages are some of the considerations that must be taken into account when selecting a screen reader ("About RNIB", 2009; "Expanding possibilities", 2009).

With screen readers blind people may have full access to the functionalities of word processors, spreadsheets, databases, programming environments, the Internet and many other applications. Still, compatibility is required between the specific screen readers and the software and between screen readers and the operating system. This means that some of the software in the market is not accessible via screen readers, because a number of rules must be met in order to access the information presented in the screen. Also, compatibility between screen readers and specialised hardware should be observed, as there are no well-defined standards. In fact, there are some considerations to take into account with respect to screen readers: functionalities; commands and their compatibility with Windows keyboard commands; quality of the voices and pronunciation; the fact that it can be tiring to listen to for long periods of time ("Expanding possibilities", 2009).

The use of such technology has been extended to different devices. One of the devices that I want to highlight is screen readers in mobile phones ("Expanding possibilities", 2009), as they have greatly eased telecommunication.

4.1.2.2. The Internet

As mentioned above, screen readers provide access to the Internet, but specific applications need to contain certain characteristics at programming and system levels to be accessible to such screen readers. This is the first step towards gaining access via screen readers. The next step is to provide the given information in a logical order and in an understandable and convenient form, so as to provide equivalent information to all users, regardless of the way they choose to access it. Also, applications should provide a friendly interface to ease navigation with the use of keys and hotkeys and ensure coherence between the different application options. It is desirable that the application can provide access to the information through refreshable Braille lines and alternative explanations of the visually based information, such as videos with no audio or text description ("Web Accessibility Initiative", 2005). The World Wide Web Consortium or W3C has produced a set of guidelines for achieving this objective for all disabilities, blindness in particular. These guidelines are called the Web Content Accessibility Guidelines (WCAG) 2.0 ("Web Accessibility Initiative", 2008), and their general aim is represented below:

- Perceivable
- Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, Braille, speech, symbols or simpler language.
- Provide alternatives for time-based media.
- Create content that can be presented in different ways (for example simpler layout) without losing information or structure.
- Make it easier for users to see and hear content including separating foreground from background.
- Operable
- Make all functionality available from a keyboard.
- Provide users enough time to read and use content.
- Do not design content in a way that is known to cause seizures.
- Provide ways to help users navigate, find content, and determine where they are.
- Understandable
- Make text content readable and understandable.
- Make Web pages appear and operate in predictable ways.
- Help users avoid and correct mistakes.
- Robust (2008) ("Web Accessibility Initiative", 2008),

For each of these guidelines there is a more detailed description on the W3C website (http://www.w3.org/TR/WCAG20/). Furthermore, W3C provides checkpoints that determine the impact of each guideline in achieving user access. Therefore, they could function as a method of evaluation of the quality of Internet applications from the point of view of accessibility.

Despite improvements in Internet accessibility and the provision of access to a large volume of information through screen readers, the amount of inaccessible information still exceeds the amount of information that is available in formats that are accessible. In fact, drawing on data from 2008 Murray (2008) states that

> […] the Royal National Institute for the Blind (RNIB) estimated this past April that 96 percent of books published in the United Kingdom are never turned into alternative format accessible to the visually impaired. (2008, p.20)

This means that blind people still rely on alternative solutions for accessing the majority of all literature.

4.1.2.3. Optical character recognition

Thus, the ability to access text material from a printed media is important to blind people in order to equalise their opportunities. One of these alternatives is optic character recognition (OCR). This is a three-step system: scanning the text material, recognising the characters and reconstructing the text for output. The scanning is carried out by a camera or specialised scanners that will produce an image of the text material. Subsequently, the system identifies characters in this image and tries to organise them, first in words, then in a structured document, taking into account the structure of the language of the text and using a spell-checker to improve the accuracy of the process. In the third step a temporal file is generated for outputting; this could be a synthesiser that reads the text aloud or *displays* the text in a refreshable Braille line or both. These temporal files can normally be saved and converted into specific formats to make them usable on standard computer software such as word processors and spreadsheets ("About RNIB", 2009; "Expanding possibilities", 2009; Child, 2003).

These sorts of solutions are available in the market as single specialised boxes or as separate components, using a computer and reusing some general components ("Expanding possibilities", 2009).

4.1.2.4. Digital books

Another alternative format for accessing literature is talking books. Initially, they were implemented on records and subsequently made available on cassette tapes to be reproduced in machines specially designed for this function. Today, talking books have entered the digital era, including functionalities like skipping to particular locations or leaving bookmarks inside the book. This technology is called Digital Accessible Information System or DAISY books. Physical formats include CDs or DVDs, but also electronic files to be stored in memory cards or made available on the Internet. It is possible to reproduce DAISY books on stand-alone devices or computers with the right software. The stand-alone solution is easier to use and learn, and if the user does not have a computer, it is also the cheaper one ("Expanding possibilities", 2009; Sajka & Kerscher, 2000).

To ease the sharing of this type of material the W3C has produced a set of standards called XML (Extensible Markup Language) and SMIL (Synchronized Multimedia Integration Language). With this coding included in DAISY books, it is possible to navigate in the book using commands through the player buttons. It is also possible to increase or decrease the speed of the reading by using a pre-programmed function that compresses the speech by shortening the pauses between words and keeping the words unaltered without distorting the voice of the reader. It is important to highlight that these formats use recorded human voices, not a synthesiser, for reading the text. Also, this format allows the text to be stored and synchronised with this voice, in case the reader wants to read it in a refreshable Braille line while listening to the book ("Expanding possibilities", 2009; Sajka & Kerscher, 2000).

4.1.3. Discussion

The influence of technology is a common subject of discussion in learning environments, alongside the concepts of generation digital gaps. How blind people read has not escaped this discussion. As made evident above reading and writing Braille on paper have not been superseded, and there are high-tech solutions for reproducing the text orally. In fact, as Bonet (2004) states, the ideal solution is for each person to be able to choose how he or she wants to read, but this is not usually the case. This duality comes from personal preference. The same Bonet explains, drawing on personal experience, that even though she had the opportunity to use almost all of the previous reading systems, she was more attracted to reading with her hands, because, as she says, ‘I get more stuck to the book through the hands than with the ears’ (Traduce by the researcher from, 2004).

But it is also true that reading Braille is a haptic function that requires that the reader learns a code, sometimes different codes, and training and practice are needed to fully master it. Many people decide not to use Braille for this reason and because reading by listening does not involve learning and practicing a special skill. On the other hand, listening does not require developing new, special skills; indeed, all one has to do is refine this natural ability and allow for the speeding up of the listening function.

In addition, tactile, auditory and also visual reading presupposes different processes, and it may therefore result in different rates of comprehension, depending on the type of literature. However, González (2004) found that even though reading Braille could take more time than other ways of reading, the comprehension is equivalent to visual reading; in the first school years it is even significantly better than listening, but this tends to disappear as the academic level increases. Therefore, the choice of reading method is a matter of individual preference.

An interesting observation is that Braille is a solution that comes from the medical perspective, since it was constructed to provide a solution that was functionally appropriate for blind people, but it does not provide access to the social flow. In this sense, using Braille through Braille lines is a solution that provides access to the text, at the same time as other people could be reading it on the screen, thus moving Braille to an integrative perspective or even beyond to an inclusive perspective. At the same time, Braille has provided access to vital information, improving the independence of blind people and enabling them to share the environment with sighted people; this turns Braille in the direction of an adaptive perspective. To conclude, the appropriation of tools is not necessarily associated with specific perspectives; however, the intentionality of the tools comes from a specific perspective.

Another point of analysis concerns the social construction of disabilities, as Braille provided people with an education, allowing them to be active participants who could now fight for their rights, echoing the slogan ‘nothing about us without us’ that has become an icon of the fight of various oppressed groups and, in particular, for people with disabilities (Charlton, 2000). This is not an empty slogan, because it is not possible to secure one’s rights if the groups concerned are not able to fight for them. Hence, literacy has been important for easing the transition of blind people from the charity model to the economic model; blind people recognised their ability to learn to the same extent as sighted people.

4.2. Mobility and orientation

Moving around freely is a basic freedom for everybody, and blind people are not an exception. To achieve this freedom two different abilities are required: orientation and mobility. Orientation is the ability to acquire information from the environment in order to construct the journey between the starting point and the destination (D'Atri et al., 2007; Strothotte et al., 1996). Such information should provide reference points, mainly permanent objects with distinct properties that identify them and their relation to other objects. These properties include shapes, positional concepts, such as ‘to the left of’ or ‘under’ textures, and the relation to other objects which can provide directions or reveal what one can expect to find next (Blake, 2003). Such identifications and relations are fundamental to determining the lines of reference that persons use to move along different reference points (D'Atri et al., 2007). Later I am going to review specific tools for orientation.

4.2.1. Mobility

The other ability for achieving freedom is mobility, which is related to the use of techniques to support displacement. These techniques are related to the use of different tools: human guides, white canes, guide dogs, electronic travel aids (ETAs) (Blake, 2003).

The human guides are considered tools as long as their function is to provide information about the environment. Blake (2003) comments on techniques for walking with human guides:

- Users should hold the guides' arm, just above the elbow, with their fingers on the inside and the thumbs on the outside.
- Guides should move at their own pace.
- Guides should stop briefly in front of the stairs but it is not necessary to stop on each step.
- Guides never have to hold the hand of the blind person.
- Blind children should prefer to hold adult guides wrist. (Blake, 2003)

4.2.1.1. The white cane

As mentioned in a previous chapter, the use of canes has centuries of history, but it was not until 1921 that it was painted white as a way to make it more visible to other people. 10 years later it was recognised as a symbol for blindness ("White Cane", 2009; Hollier, 2007; Strong, n.d.). Then, following World War II, the white cane underwent another transformation, this time in terms of the method of use, improving the social participation of repatriated veterans. Such improvements were effected by Doctor Richard Hoover who made the cane longer and emphasised its primary function as a mobility tool (Strong, n.d.). Making the cane longer enabled the user to sweep it in front of him or her to gather information of obstacles, curbs, steps up or down and changes in the surface of the ground (Blake, 2003).

Canes are of different lengths and made of different materials – straight canes, folding canes and telescoping canes – depending on the needs and preferences of the user. There are also double function canes that can be used both as white canes and as support canes. The tips can have different shapes and materials according to the preferences of the user ("Independence Market", 2009).

4.2.1.2. The guide dog

Guide dogs are used as alternatives to the white cane. The dog is trained to be aware of obstacles in the path, and this usually allows the users to move faster. Another advantage over the white cane is that guide dogs can alert its user or owner of overhead objects, such as branches, awnings or signals, that the white cane would not detect (Blake, 2003). These advantages make guide dogs the more effective mobility tool for moving around the city, especially through open spaces, even allowing the users to run with the dog as a form of exercise. The advantage of the guide dog over the human guide is significant on long trips, because both the human guide and the blind user start to feel stressed over long guiding periods and, in contrast, such stress never occurs with dog guides (Thomas, 2009).

It is important to clarify that the guide dog is not a substitute for orientation activities, as the former is neither able to identify the user's destination of the user nor the best route. Guide dogs are able to learn to stop in familiar places, but they cannot identify new buildings (Blake, 2003).

4.2.1.3. Electronic travel aids (ETA)

Human guides and guide dogs carry the responsibility of safe mobility, freeing the blind user hereof. This is not the case with the white cane, though, used by the user as a way to anticipate position, size and kind of object through the use of sensory abilities. Such interrelation between objects, the cane and the user's sensory perception entails a cognitive process in which the user learns how to identify signals in order to make decisions regarding present conditions. Memorising these situations will produce what Foulke ((1984, cited in, Sarmiento V. & Lopez V., 2004) has called 'cognitive anticipation', that is the ability of individuals to anticipate cognitively the perception of specific stimulus in the environment. As the cognitive process is limited to the use of the cane, the construction of the environment is rather more limited than the construction of a sighted person; therefore, the intention of the ETA is to foster such perception of the environment to improve the mobility of the blind person (2004).

In this context, ETAs must be supplemented with two conceptual parts, one to collect and process the information from the environment and another to inform the user. Examples of this sort of tool include ultrasonic canes or handheld canes that use ultrasonic echoes to locate obstacles ahead, not only at ground level, but also at head height. The feedback of environment conditions could be provided by vibrating buttons in the handle, indicating the existence and distance of an obstacle, or by complex multiple tones delivered via miniature earphones in other models ("About RNIB", 2009).

4.2.1.4. In the environment

Other tools supporting mobility can be built directly into the environment. A basic tool is pavements in good condition with no permanent or mobile obstructions, such as furniture or parked cars, and which have been clearly separated from cycle lanes, streets and roads. Special attention is required at road crossings, as these are places where blind walkers experience increased stress, because it is difficult for them to determine when they have reached the other side of the row; here very low guides are provided to make them feel confident that they are not veering away from the pedestrian crossing. Audible signals on both sides of the street, signalling traffic lights, are also helpful means of orientation; however, usually noise from the environment limits the usefulness of such feedback ("JCMBPS", 2005).

Lines in the pavement or changes in texture are also helpful, alerting blind pedestrians of car and bicycle crossings, even of train crossings which typically have gates only in the right-hand side of the street and not in the left-hand side ("JCMBPS", 2005).

4.2.2. Orientation

As introduced previously, orientation is affected through the use of reference points to construct a route from the original point to the desired destination. This is not always an easy task, because the environmental conditions can be very diverse and are not always static, and this is what orientation tools try to overcome.

In essence, orientation is related to the coordination required to follow a specific route and avoid difficulties without losing track of the desired destination. The term wayfinding designates the process used by persons to keep moving towards their destination, even though they need to make changes to the route as a result of unexpected obstacles in their path (Ross & Blasch, 2000).

4.2.2.1. Spatial orientation tools

Helpful tools for constructing spatial orientation include tactile maps which provide an overview of an area with walking routes. Unfortunately, these tactile maps are not common and are difficult to carry as they are quite bulky. Talking maps is another option; these maps provide routes and reference points orally (Ross & Blasch, 2000).

Another way to provide orientation information could be via the use of Braille labels on doors, street lights etc., informing blind people about the nearby surroundings; however, this solution has an implicit access problem: the difficulties that users may experience trying to find these labels (Ross & Blasch, 2000). These solutions can be used to reduce the impact of traveling with public transportation; for example, if blind users can manage to find bus stops etc., they will be able to read which bus lines stop at a given bus stop. Still this does not overcome the need to be able to read the number of the bus approaching the bus stop (Bohonos, Lee, Malik, Thai, & Manduchi, 2007).

4.2.2.2. Navigation systems

Any navigation system that is designed to help orientate and provide blind users with confidence and independence needs to fulfil two goals: provide information of the location and surroundings along the route and provide an optimal route towards a given destination (Rajamaki, Viinikainen, Tuomisto, Sederholm, & Saamanen, 2007).

In order to provide information of the surroundings, one of the two following options is required: 1) having a short range device in the environment, providing information about the immediate surroundings, directly or via a receiver, or 2) having a method for locating the user globally and a source of information about the locations on the chosen route.

4.2.2.2.1. Short range devices

- Information written in Braille, with the disadvantage that it is difficult for a blind person to locate the information (Ross & Blasch, 2000).
- Speaking signals with a pre-recorded message that warns, alerts or informs people when they approach the device. The devices are activated, for example, by movements of the body. Other variants of activation are devices that use a short-range electronic key fob. When activated the devices will provide the message orally. The devices require power sources, but can be used indoors and outdoors. These kinds of devices are a substitution for visual signs ("About RNIB", 2009).
- There are variations of the speaking signal, involving more technology in both the transmitter and the receiver. They can use infrared, visible light or bluetooth systems. In both cases, the message could be transmitted permanently or only when a receiver is detected. The system can reproduce the message

orally via speakers in the source device or via earphones, Braille, vibration etc. in the receiver. They are used as substitutes of visual signs, but can also interact with other objects such as traffic lights or public buses. In fact, these signals could be a solution to the limitations mentioned above, for instance identifying a bus that is approaching a bus stop ("About RNIB", 2009; Bohonos et al., 2007; Ross & Blasch, 2000).

- The last group of tools under this heading is mobile phones, as many of them are capable of using bluetooth and screen readers to support telephone functions, but can also be used as interface devices with other functions, with the advantage of being free of stigmas associated with specialised equipment (Bohonos et al., 2007).
- Tools using WLAN technology are situated on the periphery of both classifications. These tools are usually related to the use of portable computers and therefore involve more computer power to allow diverse and more advanced solutions. However, they are placed in the second group, as WLAN was originally an indoor solution to tools based on the Global Positioning System (GPS) (Rajamaki et al., 2007).

4.2.2.2.2. GPS-based solutions

As stated above, the second classification includes tools based on GPS solutions. Some tools are as small as a mobile phone and are able to provide the position of the user or the name of the next street or intersection ("About RNIB", 2009). This functionality is extended and used as basic information in more complex systems, such as solutions containing digital maps for providing routes through urban and rural areas, for providing points of interest close to the location of the user and for supplying feedback through different media ("About RNIB", 2009; Rajamaki et al., 2007; Ross & Blasch, 2000).

On the basis of previous information, other solutions have developed even further and become more sophisticated, for instance by adding a digital compass to provide extra mobility support. Now users will be able to correct their orientation on the basis of the information they receive from their GPS and adjust their direction using digital maps. Also, it is possible to change the route in the event of detours or blocked areas and still keep track of the final destination (Rajamaki et al., 2007; Ross & Blasch, 2000; Strothotte et al., 1996).

This could suggest that white canes and guide dogs are becoming obsolete, but this is not true; these new tools are still complementary to the main mobility tools (Bohonos et al., 2007; Rajamaki et al., 2007; Ross & Blasch, 2000; Strothotte et al., 1996). As they depend on GPS, indoor use is not viable, as a minimum an alternative indoor localisation tool must be implemented. But problems may also occur outdoors if the user is located between high buildings or caught in heavy weather conditions (Rajamaki et al., 2007). Also, it is important to consider that the precision of regular GPS systems is around 30 metres in 50 per cent of all measurements, and this increases when users approach the equator (Correia, 2002). This means that GPS precision is better in Costa Rica than in Denmark.

4.2.3. Discussion

Moving around is not an easy task, especially when the landscape is unfamiliar. The tools described in this section are still complementary to the white cane or the trained guide dog. To substitute them, the new tools need to improve their ways of reducing the volume of information that can be picked up from the environment to an optimal level to be transmitted through a non-intrusive interface (Rajamaki et al., 2007), providing an easy path to follow and a relaxing guide to the user, leaving the auditory system free to deal with unexpected situations. Ross and Blasch (2000) pointed to the integration of indoor and outdoor technologies, supporting localisation, orientation and wayfinding and to a 'handsfree' interface.

Now, considering that 80 per cent of all short distance journeys (around 1.5 kilometres) are made on foot ("JCMBPS", 2005), the relative importance of supporting mobility and orientation becomes evident, especially in university environments, where moving around a campus is often an everyday activity. Adding these elements to the facts that these tasks are still time-consuming and sometimes stressful, I want to highlight the relevance of good support in these areas, at least within university campuses. The state of the art reviews have informed us of how close these technologies are to providing such solutions, and universities should invest in research on the subject to provide solutions for their students.

Another consideration in this respect is that such solutions can offer extra information to the community as a whole; the efforts should consider the needs of everybody. This is an important step when moving forwards from the medical perspective of the cane and the guide dog, from the adaptive perspective of the white canes and ETA and from the integrative perspective of speaking signals to an inclusive perspective of, for instance, the mobility guides that are built into the environment and the orientation tools that use common devices such as mobile phones.

4.3. Tools in academia

The tools that have been discussed so far are not considered academic tools, but more general tools of high relevance in the lives and degree of independence of blind people; however, it is clear that they are fundamental for academic settings, and some people, institutions and universities believe that they are sufficient for supporting blind students. However, some initiatives to develop tools focus on overcoming difficulties inherent in the system engineering field, and in some cases it is possible to adapt them for general use in related disciplines, such as mathematics and engineering that are highly oriented to visual communication in diagrams or algorithms (Calder, Cohen, Lanzoni, Landry, & Skaff, 2007). In this section I am going to address some of these tools as an illustration of the problems detected by other universities and the solutions they propose and sometimes provide.

4.3.1. Programming

Computer programming is a relatively new activity, since computers started to use stored programmes; programming languages were developed around 1960 (Franqueiro & Siegfried, 2006; LaMorte & Lilly, 2009; Siegfried, 2006). At the time computer programming was considered accessible to blind people, as the programmes were text-oriented (Franqueiro & Siegfried, 2006; Siegfried, 2006). When the Graphical User Interfaces were introduced in computer programmes, blind programmers started to experience problems keeping in the flow. This is a paradox, since GUI was developed to ease the access of computing to the wider population, but at the same time excluded the participation of people with visual impairments. Programming was not exempt from this tendency, and now the blind programmers' problem was not only to develop graphical interfaces, but to be able to use the environments to develop programmes (Franqueiro & Siegfried, 2006; Siegfried, 2006; Smith, Francioni, & Matzek, 2000).

This process of exclusion through the use of GUI has been overcome partially with the use of screen readers and with the implementation of the inclusion policies of the W3C mentioned above ("About RNIB", 2009; "Expanding possibilities", 2009; "Web Accessibility Initiative", 2005, 2008; Bonet B., 2004; Child, 2003).

In fact, most languages and popular programming applications in particular provide accessibility through the use of alternative text-oriented environments instead of the *pointing and clicking* interfaces that are inaccessible to blind programmers, making applications fully accessible with the use of commercial screen readers. Then, research has focused on supplementary applications support that fulfil the needs of the sighted and are generally accessible to blind students (Franqueiro & Siegfried, 2006; Siegfried, 2006; Smith et al., 2000).

Based on the above, it seems that all major problems of blind students are being solved. Smith et al. (2000) clarify that programming is the basis of most of the computer sciences curricula, and usually these courses challenge many students, regardless of whether they are sighted or blind. Students need to develop particular skills to construct algorithmic solutions to certain problems, and then they need to be able to write the code while observing strict rules that define the syntax and semantics of the languages. This task becomes gradually more difficult as the number of lines increases. For sighted programmers a number of tools are available which can help them follow the structure of the programme: indentations, new lines, blank lines, colours, fonts etc. These kinds of tools are not very helpful for blind programmers using screen readers. Smith et al. have developed a tool for converting such tools for sighted users into aural tools.

The tool JavaSpeaks is intended in general for new learners to ease their navigation and production of codes, supporting the syntaxes, but it also includes accessibility elements for blind students (2000). Other tools have been developed to provide accessibility to different applications, for example Visual Basic and its different applications. These limitations have been overcome, basically with the use of scripting. Still the problem for blind programmers remains as to how to design graphical interfaces that require the organising of windows, buttons, information all together, complying with aesthetic rules (Franqueiro & Siegfried, 2006; Siegfried, 2006).

Similarly, problems occur when graphical technology is used to support the work of system engineers. This is the case of Unified Modeling Language (UML), a modelling tool that covers all the phases of the systems development and integration processes: business, architectural and application modelling, development, maintenance and further development ("Object Management Group", 2009-a, 2009-b). In this sense, UML is a tool that system engineers cannot renounce. Technical Diagram Understanding for the Blind (TeDUB) is a project that has been working with interfaces for structured graphical information, and in particular the project participants have developed a tool for accessing UML (King et al., 2004). TeDUB has identified the problems that blind programmers may experience using UML tools, highlighting that the more relevant problem is the amount of information represented in a single diagram. It is not practical to present such information in the unstructured linear way that screen readers do; thus, taking advantage of the technical definitions associated with the UML standard, it will be possible to follow the flow of the diagram and provide the user with the information that is inherent to the UML definition. In other words, the system proposed will consider the contents and the relations between the different nodes, rather than pay attention to the spatial configuration. An interesting result from the user evaluation was the need for generating the graphical representation for sighted users (King et al., 2004).

4.3.2. Graphical interfaces

The graphical interfaces are not the only barriers for blind students; there are also barriers in courses where graphics are an important part of the contents, or when explanations are supported mainly by diagrams. Courses like Data Structures, Computer Organisation, System Engineering, Network Architecture and mathematically oriented courses are some examples where diagrams are part of the curricula. TeDUB has contributed to different areas that respond to structured diagrams in the same way as for UML representation (Horstmann et al., 2004; King et al., 2004). This solution focuses on providing auditory navigational functions, so that users can access the diagram as required in order to understand and interact with it. There is another tool called PLUMB; it is also auditory and its objective is to make it easy to create graphs and di-graphs that can reproduce the content of each node and maintain the relation between nodes (Calder, Cohen, Lanzoni, & Xu, 2006; Cohen, Meacham, & Skaff, 2006). An extension of this system has been given the name PLUMB EXTRA.[3] This system enables the user to create an animation provoked by an algorithm in the structure, illustrating the behaviour of the structure dynamically. The animation will allow the user to move backwards and forwards to review the different steps of the algorithm, and it will provide this information via synthesised voices at each step. For each step, the user is able to inspect the content of the structure in order to understand how it changes (Calder et al., 2007).

Even though these types of solutions can solve the issue of graphics accessibility, it is important that they are built by tools that are identical to the ones employed by the user. The majority of graphical material in the literature, ink printed or electronic sources does not observe this. Even though the graph is available in electronic format, it can still be inaccessible to some users; it would be easier to obtain a solution if the W3C recommendations were met ("Web Accessibility Initiative", 2008). The basic approach is that every image should have a title and a description that can be reproduced by screen readers. Going even further, there is a specification called scalable vector graphics, SVG ("SVG", 2009), which also includes the attributes of the graphics that allow such a graph to be represented in a touch sensitive pad or embossed in paper. The advantages of the SVG language are its compactness and scalability (Gardner & Bulatov, 2004).

In the market there is a long list of embossers with the capacity to produce tactile graphics. Some of these use paper as their output, whereas others use plastic sheets, both entailing a heating and vacuuming process. There are systems that produce graphs using the same principle as the ones used to emboss Braille, but with a higher resolution of the dots and, in some cases, producing different heights to smoothen the degradation of the figures. Other embossers work with a special type of paper in two phases, firstly making a copy in a standard copying machine and then inserting it into the machine that will cause the black areas to ‘swell’ and the white areas to remain flat ("ATC Product", 2009; "Making Tactile", 2009; Gardner & Bulatov, 2004; Gardner, Stewart, Francioni, & Smith, 2002).

With these technologies it is possible to produce graphs with certain limitations, as they cannot be very detailed and normally Braille text cannot be added due to physical limitations in the technology. However, using the SVG standard and a compatible embosser, there is a tool that works as a supplement to the embossed graph. In this case, using a special touch sensitive pad, called ViewPlus, and a piece of software, it is possible to interact with the graph using the pad by touching the parts of the graph that contain text boxes or detailed explanations that are then reproduced orally (Gardner & Bulatov, 2004).

Other less sophisticated ways to produce graphs without using a special technology include the use of a special film, suitable for being drawn on with a rounded stylus, forming raised lines. There is also a special heater pen that can be used directly on swell paper. A more rustic tool is composed of cards and scissors ("Making Tactile", 2009; Child, 2003).

4.3.3. The situation with mathematics

Blind students face a special situation when dealing with mathematics. Despite the special mathematics Braille codes, Stöger, Batušic, Miesemberger & Haindl (2006) describe the problems that blind students face in the subject of mathematics:

1. Access to mathematical literature (books, teaching materials, papers etc.)
2. Preparation of mathematical information (Presenting school exercises, writing papers etc.)
3. Navigation in mathematical expressions
4. Actually doing mathematics (carrying out calculations and computations at all levels, doing formal manipulation, solving exercises). (2006, p.1235)

Additionally, they point out a fifth problem: the mathematical communication between sighted people and blind people is related to the previous four problems (Stöger et al., 2006).

In fact, mathematics Braille codes could be part of the solution, but unfortunately these raise additional problems. As I have mentioned in a previous section about Braille, alternative codes are not standardised globally, resulting in different codes for different languages, even countries. This means that the idea of seeing mathematics as an international language cannot be applied when using mathematical Braille codes to represent them (Edwards, McCartney, & Fogarolo, 2006).

Codes are not the only problem. Different application programmes and systems have different ways of representing mathematical expressions. To solve this, in February 2001 the W3C proposed another recommendation to provide a low-level specification to describe mathematics called

MathML 2.0. A new version has subsequently been developed; the expected time of delivery was April 2010 ("W3C Math", 2009). With the availability of this standard for representing mathematical expressions other products can use it as a basis for communicating between environments and for importing such codes into their own solutions (Crombie, Lenoir, McKenzie, & Barker, 2004). There is also another format called LaTeX, which shares the aim of MathML ("LaTeX", 2009).

However, the problem of using multiple mathematical Braille codes to provide information for people from different countries still exists. Initiatives are therefore being taken to develop tools for translating MathML or LaTeX to other formats (Archambault et al., 2004). An example of such a translator is the Multi-language Mathematical Braille Translator – MMBT. This software can read and generate both MathML and LaTeX formats, including in different notations of French, English and Irish Braille (Moço & Archambault, 2004). Other initiatives are related to the conversion into Braille for the Spanish speaking community. In this connection a set of ambiguities need to be addressed (Alonso, Fuertes, González, & Martínez, 2006).

Under this premise, the project Linear Access to Mathematics for Braille Device and Audio-synthesis (LAMBDA) proposed a new code; the idea was to internationalise a code with a set of special symbols to represent mathematics linearly, allowing its convergence into print material, speech representations with a one-to-one translation correspondence and eight-dot Braille representations (Schweikhardt, Bernareggi, Jessel, Encelle, & Gut, 2006).

So, there are solutions that can help make a correct representation of mathematical formulas in Braille, but three difficulties still have to be overcome just to cover problems one and two presented in the beginning of this section.

- The first problem is the recovery of mathematical formulas from printed documents, which, as discussed in previous sections in this chapter, is achieved with the use of scanners and OCRs. The problem is that formulas are not composed of traditional characters only, and the size and fonts of the characters, their relative position and the length of the lines of a root symbol or division lines make a significant difference in the formula. Solutions such as the InftyReader have taken all these matters into consideration, achieving very high recognition rates (Suzuki, Kanahori, Ohtake, & Yamaguchi, 2004).

- The second difficulty is the reproduction in printed ink of the formulas that are already presented in MathML or any other linear format, because these structures are not the standard formats used for sighted people. In the case of the LAMBDA system, it is possible to use MathPlayer to render the code in a two-dimensional notation (Edwards et al., 2006).
- The third problem is oral access to mathematics, especially, but not exclusively, for those who do not have advanced Braille skills. As mentioned before, LAMBDA provides a one-to-one correspondence with the symbols used in the formula representation and the translation. Such a translation is consistent with Braille, rendering and providing a non-ambiguous interpretation. The cost is the inclusion of words that are not normally included in the oral description (Edwards et al., 2006; Schweikhardt et al., 2006). Fitzpatric and Karshmer (2004) have stated that using prosodic enhancement supports the separation of spoken utterances into units, assisting and helping listeners understand the verbal presentation, reducing the need for extra symbols or words to reduce the ambiguities. This issues has served as inspiration for another project called AudioMath that deals with pauses, rising and falling intonation, and emphasis in parts on the expression to provide a spoken mathematical expression free of redundancies (Ferreira & Freitas, 2004).

So far, I have provided the answers to the first two problems and hinted at solutions for the fifth problem. Problems three and four are interwoven and are important as instruments for blind students, providing access to the practice of mathematics. Navigation is the first requirement for doing mathematics, and the system should support the construction of a kind of semantic representation of the formula, making it possible to distinguish between the different components of the expression, a root or a fraction for example. Such structures do not only facilitate the understanding of the formulas and ease the navigation through these, they also support their simplification or evaluation (Edwards et al., 2006). The LAMBDA system adopts this approach (Edwards et al., 2006; Schweikhardt et al., 2006). Basic requirements for solving equations include keeping track of the procedure, controlling the leaps backwards and forwards through the different logical units and maintaining those positions simultaneously in order to establish a correspondence between the original formulas and the ones in the process of conversion. This is the focus of the project Mathematical Working Environment – MAWEN (Stöger et al., 2006; Stöger, Miesenberger, & Batušic, 2004).

As a final step the introduction of voice into the navigation process is the objective of the Math Genie project and supported by the LAMBDA project (Edwards et al., 2006; Gillan, Barraza, Karshmer, & Pazuchanics, 2004; Karshmer, Bledsoe, & Stanley, 2004; Schweikhardt et al., 2006); however, according to Karshmer et. al. (2004) none of the projects and products mentioned here have provided a comprehensive tool.

4.3.4. Participation

Thus far I have described some problems and some tools for solving these problems, but these solutions focus mainly on helping blind students solve their own problems. However, when we are talking about computer science students at university level, Klaus (2004) stated that we are talking about people who need a lifelong learning attitude, continuous willingness and readiness to learn, implying socialisation in the form of social competences and personal communication skills. It is interesting to note the alignment of this characterisation with the Wenger proposal (1998; Wenger, McDermott, & Snyder, 2002) that I will discuss in the next chapter. This is part of the participation of students in learning processes, and it is a somewhat critical issue for visually impaired students in science education, requiring exploration of alternative tools (Arnim, Piuzzi, Nam, & Chung, 2007). From his own experience Schroeder (2009) argues that having a tool that facilitates or enhances a certain process is not good enough; students should consider whether there are better tools that allow them to perform on an equal basis with their sighted peers. Sometimes additional training is necessary.

In this context Bocconi, Dini, Ferlino, Matinoli and Ott (2007) stated that using ICT for educational purposes seems to be the solution, but even this form of student support is insufficient due to the great diversity of individual requirements. At the same time, technology is usually oriented towards solving accessibility matters, but does not focus in particular on the needs and wants of particular populations (Rosmaita, Deibel, Cohen, & Egan, 2006). When these types of approaches are applied, Raskin (2004) argues as follows:

> […] we are so taken with fixing the superficial flaws in creating systems for people with special needs that we are missing the essential need to fix some deeper flaws that handicap all of us. (2004, p.2)

In fact, Timmerman et Al. (2001) illustrate that it has been identified that in order to succeed as an engineering and computer science graduate, high levels of teamwork and communication skills are required, and such abilities are not usually well developed in engineering programmes. To overcome these deficiencies, the CSU Northridge experimented successfully with the introduction of active learning in upper level computer science classes, choosing examples that were suited for the types of students who usually took these courses and, at the same time, were sensitive to diversity and disabilities (2001). This is a good example of how fixing deep-seated flaws can solve superficial flaws and improve the conditions for the visually impaired.

According to Rosmaita et al. (2006), accessibility should be considered in a computer science curriculum from three different angles:

- *Social aspects of computing*, to generate a discussion on the role of accessibility by professionals and the discipline in question.

- *Professional practice*, in order to prepare and enable future professionals to support accessibility through the use of proper techniques.
- *Accessible pedagogy*, as a response to the enrolment of students with disabilities in career programmes. (Rosmaita et al., 2006)

On the subject of social aspects Cohen (Rosmaita et al., 2006) states that computer science professionals should focus on improving the communication abilities of people with disabilities via education and research. In the professional practice it is necessary to introduce the concept of accessibility into the curricula. In fact, very few computer science programmes address accessibility issues, and its introduction does not represent significant changes to the curriculum nor to the textbooks. Deibel (Rosmaita et al., 2006) identifies such introduction as a source of 'notions of users and user needs back into the foreground and at the same time provides numerous opportunities to engage students in critical thinking' (2006, p.64). Concerning *accessible pedagogy* Cohen (Rosmaita et al., 2006) puts special emphasis on the communication of relational diagrams or graphs, as they constitute basic tools in computer science disciplines for teaching fundamental concepts, before moving on to algorithms and coding. In addition, Rosmaita argues:

> Presenting students with a non-standard user model for web browsing (e.g., a visually impaired computer user) makes it easier for students to separate content from presentation, and subsequently code up websites in a much more maintainable way. (2006, p.64)

Therefore, this is another example of how the introduction of accessibility practices and *accessible pedagogies* improves general practice and pedagogy (Rosmaita et al., 2006).

In this process of establishing *accessible pedagogy* that encourages the full participation of blind students in the flow stream of courses there is a considerable urge to capitalise the privacy aspect of real-time chats to provide tools that allowing for sharing with others without revealing individual conditions; in some cases, such conditions induce in people a reluctance to interact with disabled people (Hollier, 2007). But it is also necessary to consider that, at the same time, such environments could be inaccessible to or difficult for people with disabilities to use, depending on the barriers that writing speed represents to mobility impaired persons or if the tool in use is not accessible to blind people (Burgstahler, 2007). This is where e-learning tools can provide environments where people's participation could be separated from their disabilities. Regardless of the relevance of e-learning, though, Seale has asserted that some areas in e-learning need to improve their knowledge of accessibility and the tools, methods and approaches that can be used. The research and the practice also need to be submitted for discussion (Seale, 2006).

However, the use of multimedia in e-learning could play a double role: if used properly, it could enhance the learning environments for all students, whether visually impaired or not, for instance by providing information about a fieldtrip that might, however, be inaccessible to people with mobility disabilities; or it could be a barrier for some students, if the multimedia resources are poorly designed (Sloan, Stratford, & Gregor, 2007). The tool for achieving minimum accessibility standards of multimedia on the Internet is, as I have mentioned, the Web Content Accessibility Guidelines ("Web Accessibility Initiative", 2008). Unfortunately, according to Burgstahler (2008-b) most distance course designs do not consider access issues.

On the other hand, learning processes providing access to material or information are not enough; *accessible pedagogy* is also required. Rose, Harbour, Johnston, Daley and Abarbanell identify three different goals for the design of *accessible pedagogy*:

- multiple means of representation;
- multiple means of expression;
- multiple means of engagement. (2008, p.46)

These three goals are part of the concept of Universal Design Learning (UDL) within the paradigm of Universal Design (UD) discussed in the previous chapter. The aim of these goals is to provide the information that is required to teach a wider range of students in different ways; to provide multiple ways of expressing what they have learnt and how this information is applied as knowledge; and to provide ways of engaging in learning contents, to stimulate the application of such information in situations that produce meaning and to urge students to continue to learn after the course (Rose et al., 2008).

1. In general, UD is a process in which choices are made from the beginning of the course design process in order to ensure that it is accessible to the majority of students, irrespective of their physical and cognitive conditions or learning styles (Burgstahler, 2007). Below is a list of UD principles defined by the Center for Universal Design at North Carolina State University, guiding the design of environments, communication methods and products that can also be applied to academic programmes and instruction:
2. Equitable Use. The design is useful and marketable to people with diverse abilities. For example, a website that is designed so that it is accessible to everyone, including people who are blind, employs this principle.
3. Flexibility in Use. The design accommodates a wide range of individual preferences and abilities. An example is a museum that allows a visitor to choose to read or listen to the description of the contents of a display case.
4. Simple and Intuitive Use. Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level. Science lab equipment with control buttons that are clear and intuitive is a good example of an application of this principle.

5. Perceptible Information. The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities. An example of this principle not being employed is when television programming is projected in noisy public areas like academic conference exhibits without captioning.
6. Tolerance for Error. The design minimizes hazards and the adverse consequences of accidental or unintended actions. An example of a product applying this principle is an educational software program that provides guidance when the user makes an inappropriate selection.
7. Low Physical Effort. The design can be used efficiently and comfortably, and with a minimum of fatigue. For example, doors that are easy to open by people with a wide variety of physical characteristics demonstrate the application of this principle.
8. Size and Space for Approach and Use. Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility. A science lab work area designed for use by students with a wide variety of physical characteristics and abilities is an example of employing this principle. (Burgstahler, 2006, Web Page)

The University of Connecticut adds two principles to this list:

9. A community of learners: The instructional environment promotes interaction and

communication among students and between students and faculty.

10. Instructional climate: Instruction is designed to be welcoming and inclusive. High expectations are espoused for all students. (Burgstahler, 2008-b, p.28)

Some of these principles are oriented towards institutional authorities, while others are strictly pedagogical considerations. Concerning the latter Higbee (2008) argues that they can be achieved by good teaching, demanding intentionality in the design in advance. In fact, the main characteristic of UD is that it is proactive in the design of inclusive environments, rather than reactive to the legal frame that enforces the use of accommodations (Burgstahler, 2008-b).

Finally, UD in Higher Education (UDHE) is more than good teaching and proactive individuals. According to Burgstahler:

> Applying UDHE may reorient the roles of faculty, student service administrators, and disabilities services. In an accommodation model, the student is responsible for presenting documentation to disability services staff who determine reasonable accommodations and, as appropriate, tell faculty and staff to implement them. In the UDHE model, there is more shared responsibility as faculty and staff take on greater responsibilities to create welcoming, accessible, and inclusive environments; disability service personnel act in a consulting role regarding these efforts in addition to their traditional role of specifying accommodations for individuals. Effective results with both models, however, require active engagement of the students as well. (Burgstahler, 2008-a, p.15)

4.3.5. Discussion

The state of the art in academic tools is in some ways ambivalent, since many areas are covered by research and tools development of a sufficient scope to offer a promising environment for blind students who wish to study computer sciences and pursue related career paths. On the other hand, most of these tools are still in an experimental stage. In general, however, I believe the existence of such tools does at least allow us to capitalise the inspiration and exemplification of what can be done to provide more inclusive environments.

An important feature of the tools reviewed is that most of them are now addressing solutions from at least an integrative perspective, considering the tools not as adaptive tools for overcoming specific difficulties, but learning from them and trying to produce more holistic solutions which take into consideration the mingling of blind students with their sighted peers and, in some cases, teachers (Crombie et al., 2004; Edwards et al., 2006; Ferreira & Freitas, 2004; King et al., 2004; Schweikhardt et al., 2006) and, even better, the difficulties that all students face and their different abilities (Burgstahler, 2008-a, 2008-b; Franqueiro & Siegfried, 2006; Siegfried, 2006; Smith et al., 2000; Timmerman et al., 2001).

The classification of tools according to the perspective each tool represents is in many cases as subtle as the intention behind the conceptualisation of them. For instance, developing a tool for blind people which is subsequently found to be applicable to sighted people in a different context will enhance its acceptability and probably help establish a better market price; however, this does not mean that the design of this tool is inclusive. A clear dichotomy in this respect is whether the design of an e-learning programme is carried out in consideration of the needs of all students, or the intention of the design is to provide a programme for blind students. The intentionality in the first case is oriented towards integrative or inclusive tools, whereas the orientation in the second case adopts an adaptive perspective. The difference is not only in the operationalisation of the same implementation, the difference is based on the intentionality in the design and in the principle of segregation. To summarise, e-learning should not be seen as a solution for the tertiary education of blind students. Instead, it must be seen as integrated in and supporting traditional education; and inclusion practices should be considered a point of departure for its design.

4.4. Tools in daily life

The market offers many different tools and blind people already make use of many practical tools or tips, such as the practice of saving tooth paste by putting it directly into the mouth, instead of trying to put the exact amount on the tooth brush without spilling it. I do not intend to cover all of these tools and practices, but I will include a subset of the tools available in the market, compiled from three Internet sites with no commercial interests, sites dedicated to supporting blind people in all of their activities ("About RNIB", 2009; "Expanding possibilities", 2009; "Independence Market", 2009). They are:

- Independence Market, from the National Federation of the Blind (NFB) (http://secure.nfb.org/ecommerce/asp/default.asp).
- Expanding possibilities for people with vision loss, from the American Foundation for the Blind (AFB) (http://www.afb.org/prodMain.asp).
- About RNIB Digital Accessibility Team, Tiresias.org, from the Digital Accessibility Team of the Royal National Institute of Blind People (RNIB) (http://www.tiresias.org/research/devices/index.htm).

I have organised the list of tools in the following groups, depending on where they are commonly used. This is not an exhaustive list of the tools available, but it is useful for giving the reader an idea of the variety of tools available and, therefore, of the difficulties in the everyday lives of blind people which these tools help ease. Tools for school include basic equipment for primary school students. Examples of tools for leisure include games and support equipment for interacting with TVs and other common leisure devices. Everyday tools associated with different needs in normal daily activities. The last group illustrates the independence of individuals in a kitchen.

4.4.1. Tools for school

- Ruler and setsquare: These tools include raised marks, numbers and Braille to read the measurements.

- Tactile and talking tape measure: In the tactile tapes marks in 1/8 of inches or in fractions of centimetres are included. The talking tapes read the measurement aloud when a button is pressed.
- Abacus: For learning basic mathematical operations.
- Hi mark tactile pens: These pens create lines and dots with a plastic-like finish to provide 3D writings.
- Talking calculator: Provides the numbers spoken and normally also has a display.
- Talking thermostat: Specific talking thermostat for use in school laboratories.
- Combination padlock: This padlock works with a combination. There are different styles: a sequence of buttons that can be pressed or parallel levers where the blind person feels or hears a click.
- Footballs and basketballs: There are different kinds of balls for different sports. Usually they contain a bell to indicate the location of the ball while it is moving, and others are fitted with a permanent beep signal.

4.4.2. Tools for leisure

- Board games: The list is long and includes games like Braille cards, chess, domino, bingo, dices, Monopoly etc.
- Electronic games: There are electronic games that interact with the user through sounds, normally taking advantage of stereophonic or three-dimensional sounds.
- Talking and voice-activated universal remote controls: There are different remote controls with different functionalities, for example talking controls or controls that allow the user to control different devices and different brands of devices, and some can be accessed by voice recognition, which makes them easy to find.
- Talking pedometer: As a supplement to exercising or walking it measures the distances travelled. It normally includes talking clocks, digital music, a radio etc.

- Audio guides: Guides that provide valuable information when the user is travelling.

4.4.3. General function tools

- Braille and talking watches: Braille watches provide tactile reference, and talking watches express the time orally. Some of these include announcements of dates and alarm settings.
- Name announcement talking caller ID: These tools announce the telephone number of the person calling. Different functions can be included: recording names associated with specific telephone numbers, storing calls, providing the date and time of calls received etc.
- Colour teller: Different tools with different capacities. Some products are able to recognise as many as 1700 different colours and shades. Speaking interfaces or high acoustic signals are used in different models. Some users can use them to establish whether there is a blue sky or it is overcast.
- Click pocket money Braille: This tool is used to mark money bills and thus help the user identify the different denominations.
- Talking indoor/outdoor thermometer: Announces the temperature at a given location orally. There are different thermometers for different purposes, establishing body or cooking temperatures for example.
- Signature guide: This simple tool provides a frame for signing documents.
- Audible battery tester: These devices produce a strong or weak buzz sound to indicate the charge in a battery.
- Talking bathroom scale: There are different models, usually supplied with an oral announcement function and large numbers.
- Some models offer different languages within the same unit.

4.4.4. Tools for the kitchen

- Liquid level indicator: Indicates when a liquid that is being poured into a container is approaching the edge.
- Freezer alarm: Used to alert users of accidental defrosting.
- Boil alert disk: This is a simple disk made of heat resistant glass or plastic that makes a rattling sound when a liquid reaches its boiling point.
- Grill alert talking remote meat thermometer: Used to determine when a meat is cooked when using a grill. Some models allow users to enter the type of meat and how well-done he or she prefers it; the thermometer will then alert the user when the meat is ready or almost ready.
- Egg separator: This tool separates the white from the yolk in a raw egg.
- Plate guard: This is to prevent food from spilling.
- Tin opener: What is special about this tin opener is that it stops automatically and thus avoids cutting the user.
- Talking scale: Useful for measuring quantities of food. There are scales with bowls or flat trays for different purposes or materials.
- Talking measuring jug: The jug is able to measure up to two litres. It can be used with liquids or solids like sugar. It announces the content quantity when a button is pressed or automatically when liquid is added.
- Talking microwave oven: This oven has a voice interface, and some models include a countdown timer that can operate independently of other uses.
- Vegetable slicer: This tool allows users to slice vegetables in adjustable sizes.

4.5. Summary

As we have seen there is a wide diversity of tools, covering different areas and activities where blind people need support. Comparing these tools to the classification made in chapter 3, it is clear that the adaptive perspective is prevalent. This list will probably continue to grow as technology improvements give producers increasingly better opportunities for developing more and better tools to support blind people. This is a good thing, at least as long as it does not remove focus from inclusion. Alongside more and better tools, societies need to move towards adapting inclusive perspectives, using tools as a media for achieving gradually better interaction between blind and sighted people, sharing experiences and providing equal opportunities for everyone.

Therefore, this chapter is important as it provides insights into the needs of blind students and existing tools, and it illustrates how blind students can cope with different situations which can be difficult for sighted people to imagine. Once we understand the scope of these tools, we are able to invent and develop new tools.

< CHAPTER FIVE >

THE CONTEXTS

You can tell folk who have been to the Blind school cause they have been taught to act like sighted people… The school just tries to make them look like sighted people. They haven’t been given blind role models, they’ve only got sighted people, telling them how they should act. (Ann, individual interview cited in Duckett & Pratt, 2001)

This research was conducted in two different countries with different conditions in terms of accessibility. It is not the purpose of this chapter to judge the state of the art in each country, but as the conditions differ it is important to contextualise the discourses, the laws, the supportive system and the conditions offered to blind students.

I discussed a few differences in chapter 2, concerning legislation in particular. In this chapter I will present in more detail the differences between the two countries.

5.1. The Danish context

Before the 1970s in Denmark people with disabilities were referred to state institutions. This was also true in many other countries; however, the resources allocated to this area in Denmark are likely to have been above average. In these places people were provided with ‘housing, education, employment, medical treatment, contact with the dentist, the clergyman, the hairdresser – everything was done within the building. In their prime, the large state-run institutions were a copy of society offering everything the residents were supposed to need' ("The Danish Disability Council", 2006, p.6). This concept started to change in the 1970s, when society began to consider these institutions somewhat outdated and understood that this was a way of isolating people with disabilities from the rest of society.

Based on the principles of the well-known Danish welfare society, in the beginning of the 1980s policies on people with disabilities were translated into four principles: the principle of compensation, the principle of sector responsibility, the principle of solidarity and the principle of equal opportunities ("The Danish Disability Council", 2006, p.4-5).

5.1.1. The Danish vision in the world integrative period

The American release of ADA in 1990 was widely discussed in Denmark, but it was not supported by the authorities and most of the disabled people's organisations ("The Danish Disability Council", 2002).

> Such laws were, in a Danish context, considered to be an expression of undesirable individualization and legalization and thus also a risk of undermining the principle of solidarity which otherwise characterizes Danish disability policy. It was also feared that such legislation would, if anything, contribute to separating disabled citizens as a group from the rest of the society and thus rather prevent than promote equal opportunities and equal participation. (2002, p.10)

In 1993 a parliamentary resolution was implemented to promote equal rights and opportunities for people with disabilities. This resolution is not a legally binding act, but a guide that suggests to the Danish society such a direction ("The Danish Disability Council", 2002).

Another relevant event was related to discrimination on the labour market. In June 1996 the Danish parliament passed the first explicit regulations within this context; any kind of differential treatment was banned by this bill (Kallehauge, 2004).

> Differential treatment means that a principle of equality shall be respected. Both direct and indirect discrimination are banned. The non-discrimination criteria in this bill are race, colour, religion, political opinion, national, social or ethnic origin and sexual orientation. Neither disability nor handicap are mentioned and it is therefore doubtful if persons with disabilities are encompassed. (Kallehauge, 2004, p.9-10)

Thus, it is evident that before 2004 Danish legislation included little mention of disabilities; however, equality is a fundamental principle in Denmark, and if the concept of disability is turned in a positive direction one can argue that as long as the principle of equality is respected, disabled people will be covered by the existing laws (Kallehauge, 2004). I would like to stress this concept, as it does not fit perfectly with the whole picture, because in contrast there are specific laws to protect the equality of women, discrimination against religion, ethnicity, sexual preferences etc. Therefore, I believe something is missing. This approach may be the right one to avoid social segregation due to structures of protection, but, if so, why do such structures exist for other cases?

On the other hand, in her speech at the ICT, Development and Female Leadership Seminar (Aalborg University) in the Utzon Centre on 26 March 2009, Lone Dybkjær stated that although the Danish parliament passed a law 30 years ago to promote equal payment to male and female workers for the same job, today women remain underpaid with about 10 to 17 per cent. This could suggest that a law was not adequate to ensure equal payment; on the other hand, it is difficult to say whether the situation would have remained the same or had worsened if the law had not been passed. I have no intention to try to answer that question, but I would like to raise it here and leave it for the locals to discuss.

The Danish Disability Council (2002) stated that the policy to provide equal opportunities was realised by the process of taking people out of the special institutions that used to take care of them.

According to Olsen (2002), this is the first step towards including people with disabilities in the social collectivity, but also argues that they must have the same rights and opportunities as the rest of society. However, according to Olsen's study of attitudes towards people with disabilities in Denmark, by 2002, in general, the interviewees agreed that 'equality of opportunity for the disabled is partially or very much lacking' (2002, p.10).

> The tendencies thus point to the population being very or decidedly dissatisfied with the public effort to improve the lot of the disabled. However, if one examines cross-cutting attitudes, the tendency changes in a less critical direction. For example, only every fourth adult simultaneously finds that "politicians do too little", that "too little few funds are used on the disabled", and that "public sector care of the disabled is unsatisfactory". On the other hand, very few respondents have cross-cutting non-critical attitudes toward the public effort to improve conditions for the disabled. (Olsen, 2002, p.13)

5.1.2. Progress in the academic field

With respect to the academic field, the Danish Disability Council (2002) stated that:

> When disabled students have been admitted to higher education, they may apply to their educational institution for compensatory measures as it is the individual educational institution which is responsible for granting handicap compensating measures. (2002, p.25)

On the other hand, in an interview the Institute for the Blind and Partially Sighted pointed out that in Denmark there is no law that compels teachers to support students with disabilities, as there is in England. Therefore, the possibility exists that some teachers may refuse to support blind students.

- The institute says that its role is to support blind people in different contexts:

- Develop social abilities. Blind people often lack such abilities. This form of support is optional, but when people decline it, they may consequently experience difficulties in the educational environment and in finding a job.
- Provide tools in the context of the SPS programme. This depends on the career the student is pursuing, but it usually includes a computer with a screen reader, a digital tape recorder, a DAISY format audio player as well as a Braille note taker and a Braille keyboard display for those using Braille. In 2008 there were about 1100 Braille readers in Denmark.
- There are three groups of blind people with regard to the tools they use: Braille readers and screen readers, speech support, and magnification with speech support.
- As there are approximately 50 different disciplines in which blind and partially sighted students are enrolled, the institute prefers to have contact with the students before they decide on a study programme. This is done to help them into the career path of their choice, addressing possible difficulties in pursuing this particular career or finding a job.

On the subject of the support offered at Aalborg University, I asked Rosa, a partially blind student who is enrolled in the university (Rosa will be introduced in chapter 7), about the services she has received from the university and her answer redirected me to the municipality which in turn pointed to the Institute for the Blind and Partially Sighted.

5.2. The Costa Rican context

The School Fernando Centeno Güel (SFCG), the first school for people with disabilities in Costa Rica, was established in 1940. Its vision was consistent with the times, and the teaching observed the principles of segregation of the medical model and of the medical perspective. Since then its most important contribution was the qualitative change of attitude that any person with any disability can receive an education. Later, the SFCG proposed to establish under their coordination specialised regional centres to attend to the special students’ needs ("Centro Nacional de Recursos para la Inclusión Educativa", 2005).

30 years later, under the influence of global integration, Costa Rica adopted the first steps in this development, initially incorporating blind and partially sighted students into the mainstream flow of education. Later, SFCG started a process which was meant to return students to their original locations, with their families, in order to attend local schools. The aim of this integration initiative was to give these students the opportunity to broaden their participation options. These initiatives were followed by other more progressive initiatives in the 1980s and early 1990s; the country responded to international initiatives to improve the understanding of people with disabilities, support the development of a new social perception and to create better opportunities for these people ("Centro Nacional de Recursos para la Inclusión Educativa", 2005).

As described in chapter 2 the integration process already started in the 1970s in Universidad de Costa Rica, as a result of fights for these students’ rights to access university studies (Stupp Kupiec, 2005).

As a consequence, in Costa Rica the development of the social view on people with disabilities has been influenced strongly by the educational response to the special needs of this group of students. The qualitative impact of this process was the enactment in 1996 of Law 7600, Ley de Igualdad de Oportunidades para las Personas con Discapacidad en Costa Rica (Equal opportunities for people with disabilities in Costa Rica) ("Ley 7600", 1996) and two years later the Reglamento de la Ley 7600 sobre la Igualdad de Oportunidades para las personas con Discapacidad de Costa Rica (Statutory of the Law 7706 about equal opportunities for people with disabilities of Costa Rica) (1998). These enactments forced all universities in Costa Rica to make all necessary changes in order to provide physical access and access to information as well as communication adjustments to include students with disabilities into the mainstream (Stupp Kupiec, 2005). The law establishes in section 14, ‘The state must guarantee the access to education to all people, regardless of their disability, from the early years until the university level. This disposition is mandatory for public and private education in all the modalities in the National Education System' (Literal translation from "Ley 7600", 1996). Then, the Statutory of the Law 7706 defines specific areas that universities must cover:

- SECTION 58: University support services. Each university must provide administrative and academic support to students with disabilities, privileging the students' individual needs.
- SECTION 59: Technical support provisioning. Any technical support required by the student must be provided by the universities.
- SECTION 60: Adapted transportation. The transportation units provided by universities should be adapted to the particular needs of the people, and it must be available to the people that need to move about campus or to academic activities.
- SECTION 62. Discriminatory acts. It will be considered an act of discrimination if the university refuses to enrol students exclusively because of their disabilities or provide the required support or access to every activity at the university.
- SECTION 63. Curricula. University curricula must include general and specific contents about disabilities in order for future professionals to apply the principles of equal opportunities.
- SECTION 64. Specific education. Universities should create programmes, career programmes and specific training in disability issues to promote equal opportunities and to fight discrimination.
- SECTION 65. Inclusion of the disabilities theme into university education. Universities should

> include content on disabilities in their academic activities, towards a permanent improvement of the conditions of life of people with disabilities. (Free translation from "Reglamento Ley 7600", 1998)

Thus, the role these enactments ascribe to the universities on disabilities matters is clear. However, so far, according to Stupp Kupiec (2005), such adjustments have been treated as a direct response to each student's special needs and the limitations imposed by the university's educational context.

In 2002 another institution was created, el Centro Nacional de Recursos para la Inclusión Educativa – CENAREC (National Resources Center for Inclusive Education). The objective of this institution is to support the educational community in trying to enhance the access, the continuance, the quality of the education and the promotion of people with disabilities in different levels, modalities and programmes in the national educational system. The focus of this group is to support primary and secondary schools, their academic and administrative staff and the families of the students. Furthermore, they aim to teach subjects on disabilities affairs and to do research in these topics ("Centro Nacional de Recursos para la Inclusión Educativa", 2005).

The Universidad Nacional has an Office of Disabilities Affairs; it is called UNA Educación de Calidad para todos. It was created in 1999 by the Faculty of Education in response to Law 7600. It is responsible for providing support for students with special needs, ensuring that the conditions of these students are the same as the conditions of their peers. This office works with students and teachers, supporting them in curricular matters (Fontana H, 2011). It has the equipment to scan documents and convert them into digital formats, it has computers with screen readers, Braille printers and embossers. The office also helps students use this equipment.

5.3. Summary

A major difference between the two contexts is that in Costa Rica neither the state nor the universities provide students with tools for personal use. They need to acquire the tools themselves with their own means. UNA provides resources for community use, while the Danish government offers equipment for individual use. It is clear that this difference constitutes a great disparity and disadvantage for blind students in Costa Rica, especially when we are talking about resources such as computer and screen readers which, as mentioned above, are necessary for academic purposes.

On the other hand, the specialised office for disabilities affairs at UNA is an important source of support for any inclusion initiative. We need to bear in mind that this office supports students with different disabilities and, consequently, with different needs, making it difficult to focus on specific areas in detail. As discussed above, its perspective remains adaptive. However, it also provides support for teachers who work with students with disabilities. Again, this support is mainly reactive, probably due to the scare resources assigned to this office. In contrast, the Institute for the Blind and Partially Sighted in Denmark has more resources and focuses on blindness in particular which allows the institute a higher degree of specialisation in designing solutions and improving perspectives; at the same time, though, the institute is separated from university students' everyday world.

An important aspect of UNA is that it is the university that assumes responsibility for the inclusion of students with disabilities, and that is likely to entail better conditions for dealing with policies and supporting the fulfilment of inclusion goals. In this research I expect to establish what influences the effectiveness of inclusion processes and, on this basis, the UNA proposal might be more or less relevant. In a Danish context, the municipality is the main authority that is responsible for supporting blind people. Municipalities are a part of the educational environment, and I anticipate that is might be difficult for the municipalities to manage and implement inclusion processes in the universities.

< CHAPTER SIX >

SOCIAL THEORY OF LEARNING – BLINDNESS

> *Because learning transforms who we are and what we can do, it is an experience of identity. It is not just an accumulation of skills and information, but a process of becoming – to become a certain person or, conversely, to avoid becoming a certain person. (Wenger, 1998, p.215)*

When we think about inclusion in connection with a university study programme, we think about learning and to what extent this learning may differ from student to student, particularly if some of these students are blind.

Taking the above reflection from Wenger as a point of departure, we learn that the process of inclusion is a matter of identities, negotiation of new identities; and if we are interested in understanding the impact of blindness in these negotiations, it is necessary to reflect on the way in which the learning process could be hindered by this condition. In other words, we need to ask: How can we support this learning by redirecting or, at least, minimising these obstacles? In this connection, it is necessary to understand the conditions that affect learning and how these conditions are altered by blindness.

In this chapter I will present the framework I have used throughout my research. I will develop the theory that is related to learning, intertwined with the concepts of blindness discussed in previous chapters. Such intertwining will allow the reader to grasp the theory of learning I employ and to understand the concept of blindness in new ways. Subsequently, I will begin to define the educational concepts to provide an overall repertoire for analysing the data and considerations regarding the elements involved in the design of educational environments. Together with the blindness perspectives provided above this should give a solid framework for discussing the considerations of inclusion in the School of Informatics for blind students.

The focus of this research is on the inclusion of blind students in educational environments, particularly in the School of Informatics at the Universidad Nacional in Costa Rica. The concept of inclusion is conceptualised as a process of social participation. Following Wenger (1998), social participation implies that students are 'active participants in the practices of social communities and constructing identities in relation to these communities' (Wenger, 1998, p.4). Their participation will foster a process of belonging, and they will have to go a step further, defining their role in the community according to what Wenger has defined as the mode of belonging, through engagement, imagination and alignment (Wenger, 1998).

1. engagement – active involvement in mutual processes of negotiation of meaning
2. imagination – creating images of the world and seeing connections through time and space by extrapolating from our own experience
3. alignment – coordinating our energy and activities in order to fit within broader structures and contribute to broader enterprises. (Wenger, 1998, p.173,174)

This approach to social participation implies that I, in viewing inclusion in the School of Informatics, do not focus exclusively on students' need of skills and knowledge; on the contrary, I am especially concerned with blind students' need of opportunities to engage in the social learning environments, focusing on their chance to belong to the community of students in computer science schools.

This means that the concepts of belonging and identity are central to the process of understanding inclusion, because it is through participation that students can come to belong and, therefore, through participation that inclusion can be achieved. In this process they mould their own identities, characterising who they are, how they think and behave, and how they mean to face their professional situations (Wenger, 1998). In fact, this participation should not be unique to blind students; it must be part of the learning process of all students (Maheux & Bednarz, 2007, 2008), and the task should be to identify whether disabilities affect this process and, if so, how.

6.1. Why social theory of learning?

Social theory of learning has been used as a framework for several research studies in educational environments – such as Ollila and Simpson (2004), Maheux and Bednarz (2008) and Cobb (Cobb, 1999) – because this theory helps answer the identity and negotiability considerations that the researchers believed were essential for students to be able to take control over their learning processes. I also argue that the social theory of learning developed by Wenger fits well with the frame of my research, as it emphasises the interaction of social structures, situated learning, identities and practices, all of them fundamental to the inclusion process, as noted in previous chapters. Now we can approach this theory in more detail, starting with a reflection of the two axes that influence this theory (Figure 6.1). The first axis locates the social theory of learning in the middle of two groups of theories: between the theories inspired by social structures as a basis for learning and the theories that give primacy to situated experiences (Lave & Wenger, 1991), meaning that learning is a process defined by participation and interaction and by the history and culture embedded in such participation and interaction. On the other hand, the second axis defines the arena in which participation and interaction and socio-historical structures define their shades and hues. This arena is where learning takes place and practice and identities interact (Wenger, 1998).

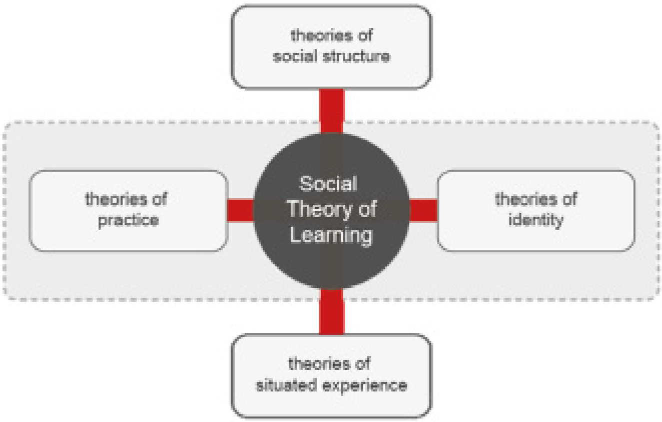


Figure 6.1. Two main axes of relevant traditions. (Wenger, 1998, p.12) The shading is included to emphasize the more relevant tension for this research.

Inspired by this structure, I propose that an inclusive educational environment is subjected to the same tensions that, according to social theory of learning, exist between the theory of social structures and the theory of situated experiences. The prevalence of social structures, under the construction of institutionalisation, norms and rules, and the social construction of disabilities, as an explanation of responses to learning, is confronted with daily experiences in routine activities and interactions with the environments as a way to give meaning to learning. As regards the horizontal axis, social theory of learning is 'the vehicle for the evolution of practices and the inclusion of newcomers' (Wenger, 1998, p.13); that is, the tension is between what is established as practice and how it should simultaneously be moulded as the identity of individuals.

- The influence that social structures has on the construction of blindness (Clements & Spinks, 2006; Hollier, 2007) is an important aspect of understanding inclusion. Examples of such structures are:

- The legislation that regulates and supports approaches to people with disabilities.
- The institutional discourses that moulding people's perception of blindness.
- The social construction of disabilities that directly influence the lives of people with disabilities through the cultural-historical construction of social perceptions.
- The different perspectives that approach solutions and different forms of support.

On the other hand, in relation to the theory of situated experiences, I am interested in the trajectories of blind students with regard to their learning processes, the tools they use, their experiences and how they relate to the educational environment in identity negotiations.

Therefore, consistent with the social theory of learning presented by Wenger, my main interest is to understand the practice and identity that can support or hinder, cope with or block, encourage or discourage the processes of learning, belonging and inclusion. Therefore, taking this perspective into account, figure 6.1 could be rewritten as follows:

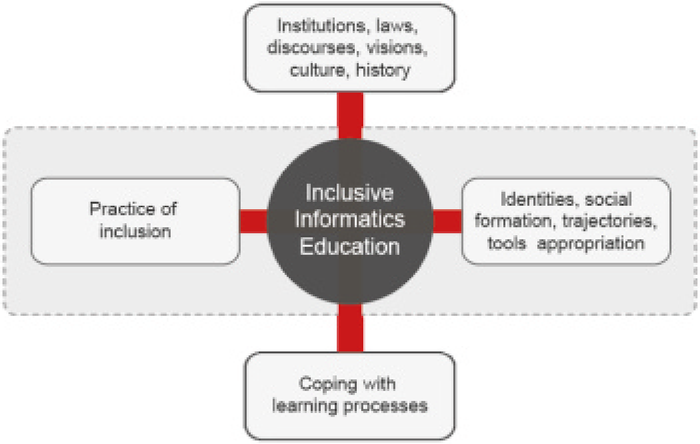


Figure 6.2. Two main axes adjusted for inclusive informatics education.

Hence, this research will follow social theory of learning, giving particular focus to the practice of inclusion and to the identity of students. Social structures and situated experiences will be referred to as elements that influence the educational environment, in early stages as well as final practices.

6.2. How learning fits with this framework

First of all I want to list the principles that, according to Wenger, summarise the social perspective on learning:

- Learning is inherent in human nature.
- Learning is first and foremost the ability to negotiate new meanings.
- Learning creates emergent structures.
- Learning is fundamentally experiential and fundamentally social.
- Learning transforms our identities.
- Learning constitutes trajectories of participation.
- Learning means dealing with boundaries.
- Learning is a matter of social energy and power.
- Learning is a matter of engagement.
- Learning is a matter of imagination.
- Learning is a matter of alignment.
- Learning involves an interplay between the local and the global.
- Learning cannot be designed. (Summarize from Wenger, 1998, p.226-229)

Thus, having established the relation between social theory of learning and the inclusion of blind students in academia, I will stress the concept that is related to the process of learning in order to support the concept of inclusive education. I will do so by echoing Wenger’s arguments that define *identity* and *modes of belonging* as the main components of education and *skills* and *information* as *secondary* terms of education (Wenger, 1998, p.263).

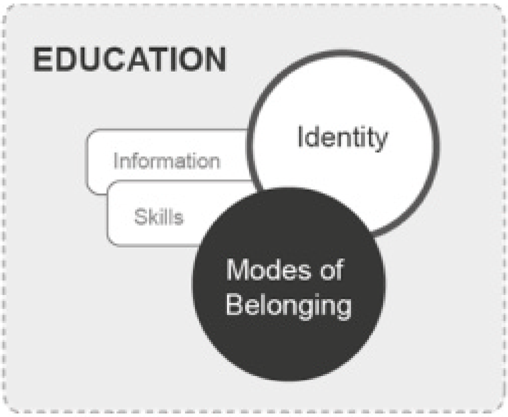


Figure 6.3. Based on Wenger's main components of education (1998).

In other words, it is not sufficient to provide access to materials; it is equally necessary to provide actual opportunities of belonging to the academic community, and this is what Wenger calls 'learning architecture':

> Talking about learning in terms of these modes of belonging makes it possible to consider educational designs not just in terms of the delivery of a curriculum, but more generally in terms of their effects on the formation of identities. Students need:
>
> 1. places of engagement
> 2. materials and experiences with which to build an image of the world and themselves
> 3. ways of having an effect on the world and making their actions matter. (Wenger, 1998, p.270,271)

Moreover, a curriculum that is not oriented to the individual needs of students and, therefore, does not take into account elements of the students' identity processes would merely foster the participation of individuals who already have an identity of participation and, at the same time, limit the participation of the others (Wenger, 1998).

Therefore, I wish to stress inclusion perspectives, not solutions based on accommodations that support blind students in a sphere that is isolated from the rest of the academic community. Accommodation approaches allow students to access information and develop different skills, but overlook means for appropriating meanings that will be available to the rest of the student population. According to Rose et al., it is necessary to provide multiple means of representation, multiple means of expression and multiple means of engagement (Rose et al., 2008, p.46).

Therefore, following Rose et al. (2008), the problems of individual students with disabilities can be addressed from two different approaches: 1) focusing on the individual and problems as stemming from him or her or 2) considering these problems part of the design of the learning environment. They argue:

> …both approaches are important from a pedagogy standpoint. In their intersection, moreover, we will find solutions that are not only more economical but also more ecological. (Rose et al., 2008, p.59)

In this sense, the process of inclusion should look for an integral solution to the problems that fall under this duality.

As was listed above, learning transforms identities and constitutes trajectories of participation. Therefore, if blind students are not met by an inclusive environment, these students will transform their identities in a different way and produce their trajectories of participation in a different way, resulting in experiences of non-participation. Students with such experiences of non-participation risk moving towards a practice of non-participation, then establishing *marginality* participation (Wenger, 1998). This practice of non-participation can hinder learning and fundamental negotiations of meanings. I associate this practice with the practice of the blind students and contrast it with the practice of the rest of the students.[2]

[2] I deliberately use 'the practice of the rest of the students' to simplify the discussion, without considering different possible practices due to different identities and the trajectories of other students.

Consequently, these two practices could result in continuities and discontinuities, what Wenger refers to as *boundaries*. These boundaries of participation and reification can ‘act as sources of social discontinuity and as connections that can create continuities across boundaries’ (Wenger, 1998, p.104). They can be reified not only by practices, but also by *explicit markers*, like blindness. Wenger states that the effect of this and any other explicit markers in the definition of boundaries depends on their impact on participation. Examples of these *explicit markers* may be the artefacts used as adaptive technologies in connection with the adaptive perspective. These artefacts may work as *boundary objects* (Seale, 2003-b), defined as ‘objects that serve to coordinate the perspectives of various constituencies for some purpose’ (Wenger, 1998, p.106). It sometimes turns out that they work as reifying connections instead of supporting participation between different membership groups without actually bridging the gap between the perspectives and the meanings of various constituencies (Wenger, 1998).

Therefore, special attention is required to reduce the need of boundary objects that work as elements of social discontinuity and improve the design of artefacts, adopting the first step in the UD definition of the Center for Universal Design (CUD) at North Carolina State University to ensure that blind students will be able to develop skills and receive the same information as other students:

> … the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. (The Center for Universal Design, 1997 cited in Burgstahler, 2008-b, p.26)

According to Hildreth and Kimble, these boundary objects need to ‘be robust enough to travel between communities, but must also be capable of local interpretation’ (2002, p.15). This means that to interpret such boundary objects some knowledge from the local is required, and if they move beyond local boundaries, they will require this knowledge. In other words, such artefacts depend on alignment with the corresponding practice.

In the end, the negotiations of meanings, practices, boundaries and boundary objects are relevant parts of the educational environment, and I will have to journey into this environment to discover the possible hurdles that can block students' opportunities of belonging. Furthermore, it is necessary to think about spaces, materials, experiences and accommodations that may need to be developed, and not think of the 'deficits' of blind students, but of the development of a new and inclusive community.

6.2.1. The educational environment

As explained above (see figure 6.4), the educational environments are constituted by two main components: the modes of belonging as a process of identity transformation and identity in itself. In this section I will discuss the modes of belonging and their implications in the conceptualisation of an inclusive educational environment.

In fact, these modes of belonging are the aspects that will make the difference in the levels of inclusion in a faculty. By addressing these modes of belonging we can provide an educational environment that eases students' negotiation of meaning and provides negotiations of practice and identity, allowing students to construct a new way of approaching impairments and reducing disabilities. These sorts of negotiations are the ones that stimulate the faculty to move towards a more inclusive educational environment to achieve a holistic inclusion concept.

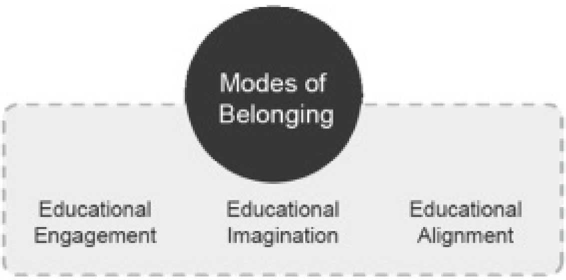


Figure 6.4. Based on Wenger's modes of belonging (1998).

6.2.1.1. Educational engagement

To achieve this educational environment it is necessary to provide spaces where students can shape their identities and give meaning to subjects through their own participation in different activities; this allows them to engage with the knowledge and its relation to their own world. Wenger calls this process educational engagement, and the infrastructure should provide the spaces for students to share engaged activities, responsibilities and challenges among themselves and with other people, to stimulate their inspection into their own practices and the practices of others, and to generate a sense of commitment around them (Wenger, 1998).

Figure 6.5. Based on Wenger's educational engagement concept (1998).

6.2.1.2. Educational imagination

Another area where an inclusive approach is needed is *educational imagination*, in pursuit of a better understanding of different roles that students can adopt in their formation and in their work lives. They will need to reflect and acquire a certain degree of self-consciousness regarding their own identities, their strengths and weaknesses, what they are able to do and what they are not able to do – but only after having participated and negotiated meanings and identities, after having belonged to practice on an equal footing with the other students (Wenger, 1998). In Wenger's words,

> If the purpose of education is not simply to prepare students for a specific capability, but rather to give them a sense of

> the possible trajectories available in various communities, then education must involve imagination as a central way. Students must be enabled to explore who they are, who they are not, who they could be. They must be able to understand where they come from and where they can go. (Wenger, 1998, p.272)

This *educational imagination* will deal with orientation, reflection and exploration; students should face a rainbow of options, different ways of going about their lives, their experiences, their practices and locating themselves in it, different ways of establishing their own trajectories, setting aside any social prejudges associated with their physical disabilities in order to define which opportunities are available with the abilities available. It is about ‘identity formation as an expanding image of the world. […] it is about identity as self-consciousness. […] it is about identity as a creation’ (Wenger, 1998, p.272-273).

I want to stress the fact that these kinds of elements should exist for all students, regardless of their particular abilities and difficulties. It may make it more difficult to provide these elements, particularly to blind students, if the current university practice does not take them into consideration.

Educational imagination is particularly important in the design of an integral concept of inclusion in a university, because it forces us to think of preparing future professionals to reflect on their own identities and providing them with the abilities to explore new ways of doing their jobs.

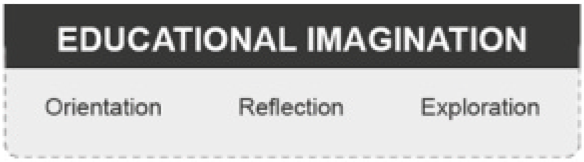


Figure 6.6. Based on Wenger’s concept of educational imagination (1998).

6.2.1.3. Educational alignment

The third component of modes of belonging is *educational alignment*.

> Educational design must engage learning communities in activities that have consequences beyond their boundaries, so that students may learn what it takes to become effective in the world. (Wenger, 1998, p.274)

This is precisely the goal of inclusion and, primarily, of bridging the gaps in academic community membership between the sighted and the blind, in all of its extension. Then, this multi-membership should prevail in professional practice, but it should not be accidental; it should come from sighted and blind students' common trajectory and from practice itself.

The educational environment needs to facilitate the empowerment of blind students to pursue participation on equal terms, not only through engagement in local practices or through their imagination with regard to future expectations; the educational environment also needs to provide experiences that prepare blind students for the real world and give them the tools to face it with. The educational alignments that Wenger (1998) identifies include: boundary processes, experiences of multi-membership, styles and discourses of broader constellations and institutional participation.

Boundary processes

For the sake of learning, boundaries need to be pushed to allow participation with other communities, thereby enabling students to negotiate meanings and identities in different settings (Wenger, 1998), not only those defined in an educational and controlled scope. For blind students this process is of particular relevance, as it prepares them for the real world that can be hostile and unprepared, with no inclusive practices.

Experiences of multi-membership

Experiences of multi-membership can work as a vehicle for improving the abilities of blind students to conciliate their own practices with other practices. This sounds contradictory with the implicit goal of developing a single practice in the educational environment for blind and sighted students, but there is a substantial difference. This single practice is intended to provide an environment with full student participation to maximise their processes of learning, while multi-membership experiences are intended as exercises of the integration of other practices into their own in order to broaden their horizon.

Styles and discourses of broader constellations

An important part of alignment comes with the use and appropriation of ‘the styles and discourses of the constellations in which it expects to have effects’ (Wenger, 1998, p.274). Such appropriation should be stimulated by the learning environment. Although such appropriation is not only defined by the curricula, it is expected to define the basis of the styles and the discourses of each specific discipline. If this definition is made through the curricula, it is important to be aware of the contents or skills that play a key role in such definitions. This is important in that such contents or skills could represent a challenge for blind students due to accessibility limitations. Therefore, a teacher’s decision to waive them could deprive them of such a basis, and this might hinder their chances of using or appropriating the corresponding styles and discourses. If such discourses are not appropriated by the students, it could limit their belonging in their educational context and have extended consequences in their future workplaces.

Institutional participation

According to Wenger:

> A learning community must be given opportunities to become involved in the institutional arrangements in the context of which it defines its enterprise. As I mentioned earlier, a large part of institutionalized educational design consists in an apprenticeship in institutional identity. (Wenger, 1998, p.274)

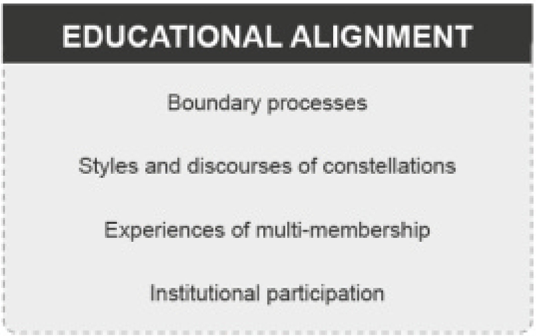


Figure 6.7. Based on Wenger's concept of educational alignment (1998).

6.2.2. The educational infrastructure

The educational infrastructure defines the areas of impact in the process of inclusion, suggesting situations where identities might play an important role for inclusion or where it might be necessary to look for solutions to:

- Allow blind students to reshape their identities.
- Facilitate the negotiation of meanings that are fundamental to their studies.
- Provide spaces where practices can be negotiated to produce new inclusive practices and ease blind students' processes of belonging, without limiting their participation with the rest of the academic community.

Additionally, these structures should stimulate the convergence of existing practices in a new practice that incorporates the practice of blind students. Such structures should stimulate a revision of their processes of belonging to incorporate elements that give meaning to all students, irrespective of their abilities and disabilities.

These concepts of belonging – together with the key concept of identity that is always present in learning processes – are educational resources that should be available to all students, but which are clearly associated with a design that is not always easy to achieve. Wenger illustrates one of these design difficulties in establishing a balance in the relation between *newcomers* and *old-timers*: blind students that arrive with their practices in a context dominated by *old-timers* and their visually oriented practices (Hatwell et al., 2003; Hollier, 2007; Jernigan, 1994-c; Kaplan, 2009; Núñez B., 2001; Villalba S. & Martínez L., 1999), carrying stigmas and prejudices (Jernigan, 1994-a; Rebick, 2001):

> There are all sorts of reasons to shelter newcomers from the intensity of actual practice, from the power struggles of full participation and possibly from the abuses of established members. Similarly, there are all sorts of reasons to shelter old-timers from the naiveté of new-comers and spare them the time and trouble of going over the basics. (Wenger, 1998, p.275)

Now it is important to recall that the process of inclusion is not a process that belongs to blind students or to the academic board; it is a process that belongs to the entire academic community (Burgstahler, 2008-a, 2008-b; Rose et al., 2008; Seale, 2003-a; Witt & McDermott, 2002). In this sense, the establishment of such a balance becomes easier, as the old-timers incorporate inclusion concepts into their practices.

However, in the meantime, before the old-timers begin to initiate processes of identity renegotiation and become aware of other identities, or if they have no intention of crossing boundaries to other communities, it is necessary to ensure that newcomers are neither marginalised nor marginalise themselves, crossing boundaries without renegotiating meanings and identities, trying to survive in isolation via improvised solutions and individual choices as to what to do and what not to do. ‘Without mutual engagement and accountability across generations, new identities can be both erratically inventive and historically ineffective’ (Wenger, 1998, p.276).

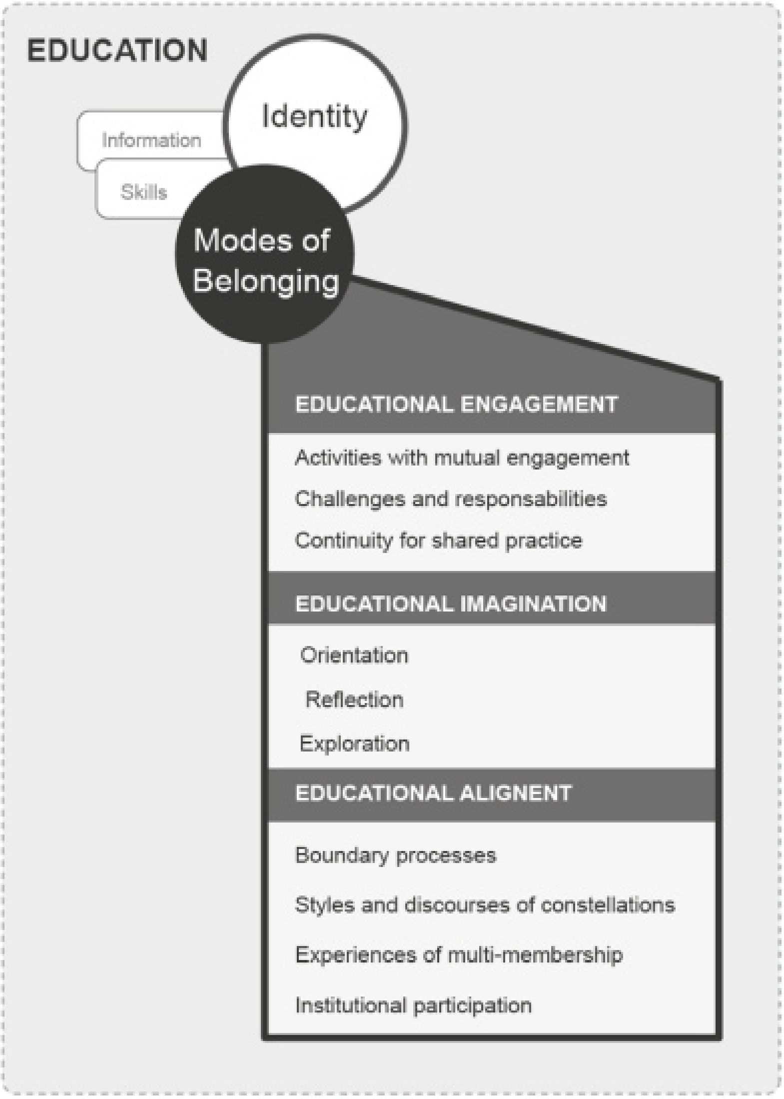


Figure 6.8. General overview of education, following Wenger's perspectives (1998).

6.2.3. Designing an inclusive environment

A process of inclusion in an educational environment needs to go beyond artefacts and general policies to support blind students to take part in learning processes (Rose et al., 2008; Schroeder, 2009; Wenger, 1998). This requires that an environment is created, including an infrastructure that facilitates and fosters the belonging of blind students in the given educational context. However, this environment should not be seen as an environment for blind students, but a single environment for all students, fostering the students' full participation, anticipating possible difficulties and providing adaptive tools for overcome most of them, not as a reaction to the individual needs of the students (Behling & Hart, 2008; Burgstahler, 2006, 2008-a, 2008-b; Rose et al., 2008; Scott et al., 2003; Seale, 2004, 2006; Silver et al., 1998; Villa & Thousand, 2005). Without such an environment students with visual impairments will try to overcome difficulties by using the tools that they are familiar with, giving them a false perception of being included and experiencing what Wenger (1998) calls the *marginality of competence*. Furthermore, if the students cannot fully participate in some of the learning activities due to their disabilities, it may also produce a *marginality of experience* in their learning processes.

6.2.3.1. What is the role of design for learning?

I could start by presenting Wenger's definition of design for learning:

> By 'design' I mean a systematic, planned, and reflexive colonization of time and space in the service of an undertaking. This perspective includes not only the production of artifacts, but also the design of social process such as organizations and instruction. (Wenger, 1998, p.228)

This definition is somewhat consistent with what I have discussed so far, and we therefore need to extend educational infrastructures with components that provide such artefacts as well as social practices. But this is not something that can be done from a desk, so to speak; it will require continuous participation by the entire community, because:

> […] learning cannot be designed. Ultimately, it belongs to the realm of experience and practice. It follows the negotiation of meaning; it moves on its own terms. (Wenger, 1998, p.225)

This does not mean that this is the final statement of my research, because to some extent we have been dealing with this matter to provide insight into this process, expecting it to be a sort of boundary object that identifies areas of action, establishes a point of departure for learning designs for blind students and which may possibly be designed in practice, providing certain affordances (Gibson, 1979) for the negotiation of meaning (Wenger, 1998).

Because learning is related intrinsically with practices and identity, the same practice is going to enhance the educational environment, providing part of the architecture that will support the negotiation of meanings through different memberships, and reshape the identities of the academic community into a single one that incorporates the concepts of inclusion. In fact, even the design of artefacts as boundary objects needs to privilege the premise of ‘designing for participation rather than just use’ (Seale, 2003-b, p.7).

Talking about educational environments, one might be tempted to address this research through didactics for blind students. In this context I prefer the concept of design to didactics, as educational environments are expected to have a developed strategy that is aligned with certain didactic lines, and our concern is to make them accessible to blind students and design the educational environment in the wider conceptualisation of the inclusive perspective. This will probably require didactics adjustments, but only as a response to the general design.

To support the design for learning Wenger proposes a set of four dualities that define areas of tensions, which we need to consider in the design process: participation/reification, designed/emergent, local/global and identification/negotiability (Wenger, 1998).

Participation and reification

The tension established between reification and participation is caused by the community's degree of reification and the space left for participation. For instance, in a curriculum some reification could be a good guide, especially for newcomers to ensure their membership of the community. However, if reification does not leave space for students' experiences, it might, as a negative consequence for the student, 'seem to lift knowledge out of practice, and thus to obviate the need for (and complexities of) participation' (Wenger, 1998, p.265).

This is particularly relevant for the students who need to redefine their practices due to their blindness, because the curriculum and the academic community are not aligned with concepts of inclusion. In this situation, the blind students would be more prone to excessive reification and, thereby, 'learning can lead to literal dependence on the reification of the subject matter, and thus to a brittle kind of understanding with very narrow applicability' (Wenger, 1998, p.265).

Wenger's analysis of this situation clarifies the balance between reification and participation, attaching importance to the negotiation of meanings through either one, or both, artefacts and people, to provide affordances to the negotiation of meaning (Wenger, 1998). Then, we can understand participation and reification as the negotiation of meanings based on artefacts and on people.

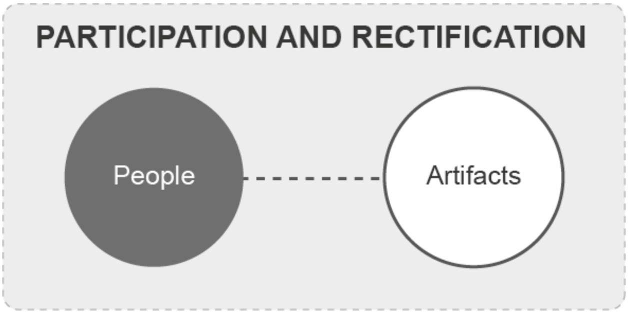


Figure 6.9. Duality of participation and reification, based on Wenger (1998).

The designed and the emergent

The most relevant effect on design is that,

> There is an inherent uncertainty between design and its realization in practice, since practice is not the result of design but rather a response to it. (Wenger, 1998, p.233)

In this sense, it is necessary to be clear about this premise of learning, because 'the relation between teaching and learning is not one of simple cause and effect' (Wenger, 1998, p.264). This means that teaching may have intentionality, but does not necessarily generate learning, because learning needs to be related to proper practice that provides meaning to students (Wenger, 1998). Therefore, the duality of the designed and the emergent also needs to find a balance; while design should be sufficient for providing a structure, guiding what is important in the learning process, it is necessary to allow space for what may emerge from the structure of practice and from the structure of identity.Consequently, it is crucial that learning and teaching practices converge in a single practice. In particular, in attempts to deal with inclusion it is necessary to add this other component to this practice of convergence. Blindness should be considered in both practices, as an element in the design of teaching practices and as an element in the negotiation of meanings, moving from the practices of blindness into existing learning practices.

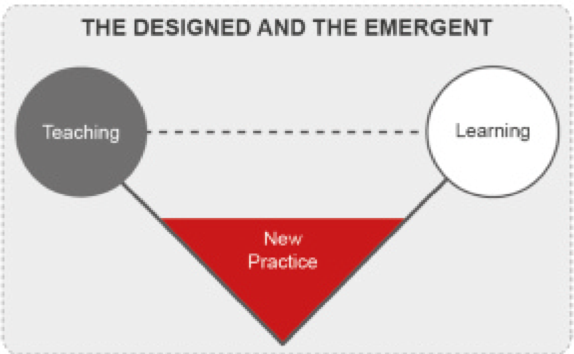


Figure 6.10. Convergence of the designed and the emergent, inspired by Wenger (1998).

The local and the global

> To say that communities of practice must be involved in the design of their own learning is not to suggest that a local perspective is inherently superior. Recognizing that communities of practice will generate their own response to design does not imply that they must be left to their own devices. Indeed, communities of practice are only part of the broader constellations in which their learning is relevant. Every practice is hostage to its own past and its own locality. (Wenger, 1998, p.234)

The concept of inclusion is likely to fit better with this duality, because, regardless of their degree of preparation, the practices of schools will have been negotiated throughout their existence, and inclusion is a concept that evolves from day to day. Hence, new negotiations between school practices and the new needs arising from the practices of blind students must take place, constantly and independently of any other practice. It is interesting to stress that the inclusion of the same concept of inclusion should transform the practice of any school and professional practice, as it will make visible the responsibility of universities to observe and comply with the different laws in different countries (particularly in Costa Rica's Law 7600 (Costa Rica, 1996)]), ensuring the effective inclusion of all persons in the society. Moreover, if the universities fail to prepare their students for this concept, they lose important alignment with the spirit of the law.

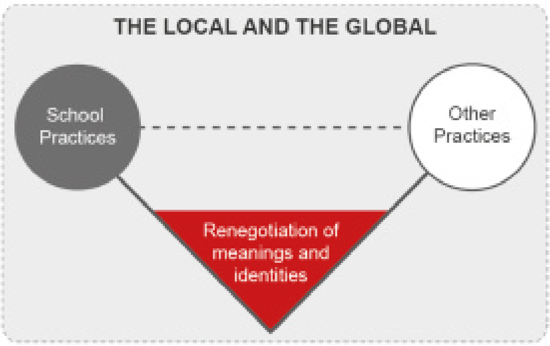


Figure 6.11. Duality of the local and the global, inspired by Wenger (1998).

Identification and negotiability

On the subject of design, Wenger says:

> As a process of colonizing time and space, design requires the power to influence the negotiation of meaning. (Wenger, 1998, p.235)

Contrary to the power that inclusion might have on the tension between the local and the global, the tension between identification and negotiability is what should influence the inclusion process. This means that having the space and time to stimulate the negotiation of identities would ease the process of inclusion. In this sense, as I focus on the current infrastructure and consider aspects that schools should pay more attention to in order to ensure inclusion, I need to find ways to stimulate such negotiability in areas where blind students need it.

Figure 6.12. Duality of identification and negotiability, inspired by Wenger (1998).

Such negotiability should not take blind students as its point of departure. Considering the fact that most blind students who arrive at university are likely to have been exposed to such processes of negotiability and identification throughout their lives, the most relevant process is probably the one related to their sighted peers. The latter have probably had little or no contact with blindness; therefore, they have never had the opportunity to negotiate their identities against concepts of exclusion, or they struggle with their own perspectives on blindness. It is necessary to consider that these students may have their own social construction of disabilities, generating a wide range of perceptions, from charity models to economic models. In this sense, sighted students need to initiate their own processes of identity negotiation in order to incorporate these new concepts and be able to move towards inclusion. They are not the only ones who need to negotiate identities; this process should also include the teachers, but as they have a more permanent presence, they can be part of the design process, facilitating the process of negotiability, not waiving it.

6.2.3.2. The learning architecture

We have a complete picture of what Wenger (1998) calls the dimensions of design and how he uses them as his framework for designing for learning. They are summarised below:

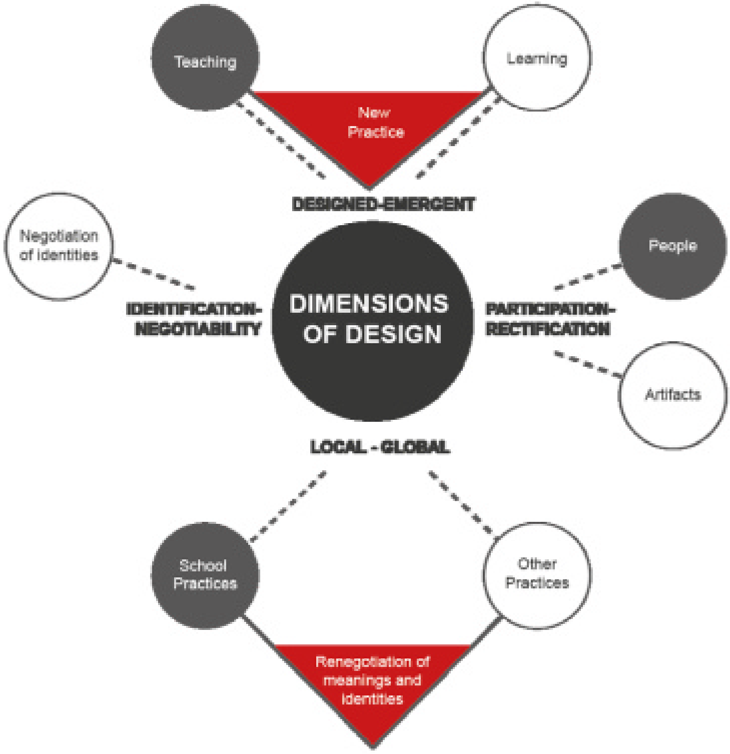


Figure 6.13. Based on Wenger's dimensions of design (1998).

On the basis of these dimensions of design the next step is to design facilities that accommodate the three modes of belonging discussed above: educational engagement, educational imagination and educational alignment. This means that the design needs to provide support to achieve these three main components of the educational infrastructure which, according to Wenger, constitute the *learning architecture* (Wenger, 1998).

6.3. Why is this framework useful to my research?

I have described the educational infrastructure and the architecture of design concepts and their relation with blindness concepts, revealing a strong interconnection between them and providing an altogether solid framework for discussing the theme of inclusion in educational environments, in particular in university settings in the School of Informatics at the Universidad Nacional.

I argue that such a framework is sufficient and exceeds the requirements to support the discussion concerning the fundamental understanding of the dynamics of identities and their negotiations, trajectories, social structures, stigmas, practices, participations, spaces and times, meanings and their negotiations, boundaries, memberships and multi-memberships, disabilities and abilities, all of which interact. It is probably possible to see only some of them, maybe some of them do not have a solution in the university context, maybe many of them have many different manifestations; some of them will be interwoven, others isolated; maybe none of them can possibly be covered in depth. Finally, though, the important issue here is to use these aspects to connect as far as possible the infrastructure and the architecture and give different meanings to the inclusion process, taking the concept beyond the simple introduction of tools or obvious curricula adjustments. This will undoubtedly improve our view of the meaning of the process of inclusion.

> It is that learning – whatever form it takes – changes who we are by changing our ability to participate, to belong, to negotiate meaning. And this ability is configured socially with respect to practices, communities, and economies of

> meaning where it shapes our identities. (Wenger, 1998, p.226)

Finally, we can consider the research framework a ‘coupling’, putting all the pieces together, having an infrastructure that is adjusted by architecture, considering the inclusive environment a platform for generating meanings, practices and identities from the perspective of blindness. The following figure illustrates this coupling:

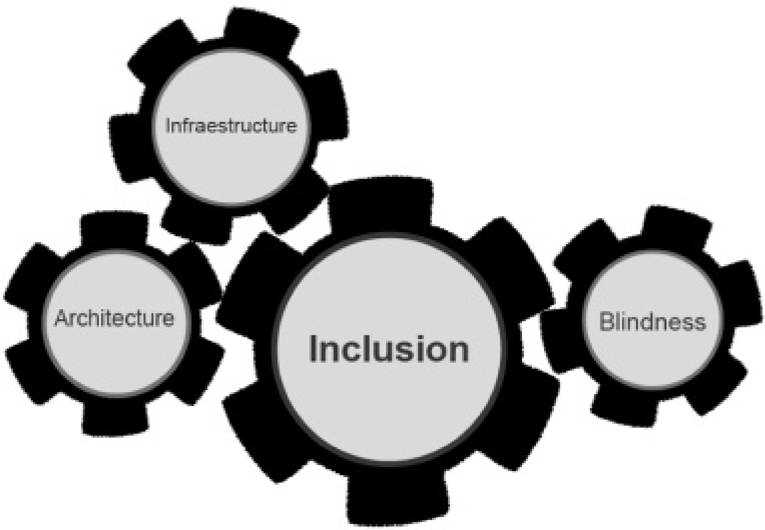


Figure 6.14. Research framework.

< CHAPTER SEVEN >

METHODOLOGY

In this chapter I will discuss the methodology used to construct the data to generate assertions and conclusions that can support UNA and the School of Informatics, in particular, in their efforts to produce an inclusive System Engineering career programme.

I will argue that this research is based on an interpretivist/constructivist paradigm (Mackenzie & Knipe, 2006), inspired by ethnography as a way of looking at the construction of data and learning and understanding the phenomena (Cohen, Manion, & Morrison, 2000; Davis, 2000; Fetterman, 1998). I have conducted case studies (Stake, 1995; Yin, 2003), drawing on interviews, observations and documents as methods for data gathering. Furthermore, it is important to note that the study makes use of social models that are oriented towards the inclusive paradigm in particular, as described in chapters 2 and 3 (Duckett & Pratt, 2001).

7.1. Changing paradigms

With a background in computer sciences I needed to move from a positivist orientation to a paradigm that allows me to view the problem from the point of view of the students and the institutions. In the beginning, my background helped me, methodologically speaking, revise the tools that help blind people overcome their disabilities, but eventually I needed to move on to an interpretivist/constructivist paradigm (Mackenzie & Knipe, 2006), inspired by ethnography to go beyond the tools and look for the holistic conditions required to study computer sciences at the School of Informatics in the Universidad Nacional in Costa Rica (UNA).

This move was accompanied by the transition proposed by the same research on blindness, establishing a mix of paradigms. In fact, blindness, as it was described in chapters 2, 3 and 4, was explained using different paradigms, paradigms which in chapter 3 were characterised as perspectives. Then, using the same description to ease the discussion, the contribution of the medical perspective is positivistic, as it was constructed on the basis of the physical considerations and the functioning of the organs. I could add that the adaptive perspective is also dominated by the positivist paradigm, while the other perspectives move towards a transformative paradigm and are mainly based on qualitative research (Mackenzie & Knipe, 2006).

7.1.1. Changes in the researcher perspective

Since no blind students study computer sciences at Aalborg University, I decided to start asking students with different disabilities about their experiences and, thus, determine whether the Department of Computer Science has made progress in this area. Then I conducted an interview with a visually impaired young woman that studied English and International Relations, who I will call Rosa, with the objective of trying to grasp her situation in the Danish context and how she and the university managed her impairment.

Rosa was born with cataract and glaucoma, which means that she has been visually impaired since birth with residual sight. This condition limits her abilities to read continuously, but she managed to complete primary and secondary in regular school. It was not until later at university that her sight deteriorated and Rosa's reading requirements intensified. Still, she graduated first as a Bachelor in 'English and German Language for Specific Purpose'[3] and then as 'Master in English and International Relations'[4]. She worked in Nairobi, Kenya for seven months

[3] The career' name was provided by Rosa in the interview
[4] Idem

and when she returned she began her PhD in mathematics education in multicultural settings.

Although Rosa is partially sighted, she gave me deep insights into the difficulties of being impaired and important information about the potential situation of blind students, as she uses some of the same tools and experiences some of the same difficulties. It was particularly interesting to hear that most of the problems she has to face are not directly related to her tools, and I understood that she has a set of tools that allows her to deal with all student situations. In fact, she began having problems when she was not able to read many of the required books and she asked if she could get the books on tape. These books were usually delayed, as they were converted to tape form at another location in Denmark, and Rosa had to queue like any other user. This usually took one to two months and it forced her to retake the course in question a year later. Often her teachers did not state in advance which books they planned to use in the coming semester, limiting Rosa’s chances of ordering her special books in advance.

She pointed to another problem in this respect. Aalborg University works with a project-based methodology, which means that it is not possible to say in advance which books will be required, as individual projects differ and the material is defined along the way. Her situation improved during her master studies, where she had access to the DAISY format; this improved her reading practices, but did not solve the problems associated with the project-based approach.

Another problem was the fact that she has little chance to prepare for university in upper-secondary school. Rosa would have liked to get some form of assessment to determine which areas she had to work on before entering university. She explained that today a central unit located in Hellerup (The Institute for the Blind and Partially Sighted – IBPS) gives some support in this direction via sessions with counsellors and study advisers, but according to Rosa the institute concentrates its efforts on support devices and do not assess the students and their specific needs in connection with their specific career choices and abilities. This central unit also failed to enter into dialogue with the universities to inform them about possible technical adjustments or solutions. She warned that this could potentially erect barriers for students who wish to enrol in certain career programmes.

I wondered if the situation could be the same for blind students as for partially sighted students and if the situation could be the same for computer science students. Also, Rosa's intervention made it clear that even though she had the tools, collateral situations influenced their effectiveness and situations arose in connection with students' enrolment in different career programmes and their individual needs. She also mentioned some risks connected to the counselling management and the conditions offered in different university schools. Thus, questions arose: Why are there no blind students in computer science career programmes in Denmark and Costa Rica, when in both countries these programmes have one of the highest student recruitment levels? Are the schools prepared to receive blind students?

To address these questions, two new interviews were arranged. The first interview was with the head of the Department of Computer Science (DCS). The situation in this department was not that different from the situation in the School of Informatics in Costa Rica, as none of the schools have developed specific and institutionalised ways for coping with blind students. They were not prepared to receive them, they did not have a clear idea of how to go about it, and they expect to deal with blind students on a day-to-day basis. Also, both schools relied on specialised offices to eventually find a solution: in Aalborg with the participation of the above-mentioned institute and in UNA with the participation of the internal Office of Disabilities Affairs (ODA).

The second interview was held in the IBPS in Hellerup. In this interview I was informed by the person in charge of IT support for the visually impaired, a former programmer who had been blind since birth, that the answer to my research focus on what computer science students need to study at university had already been provided by a customised package of tools, offered by the IBPS, and that there was no reason to continue with my research; therefore, he advised me to shift my focus (Vargas, 2007). On the other hand, I received other relevant information about the counselling provided by the IBPS from a student counsellor. The IBPS counsellors try to affect the students to choose career programmes that are already prepared to receive blind students.

I detected a cause-effect situation. If the problem had already been solved, then why do schools need to be prepared to receive blind students? Is something else going on? I found that this last comment contradicted with the previous assertion by the IT support counsellor. Are these ‘other things’ discouraging blind students from trying to access technical and scientific career programmes? And is this related to the use of tools?

Solving the tools-based accessibility problems does precisely entail looking for solutions in between the medical perspective and the adaptive perspective, as defined in chapter 3. Trying to address possible solutions from the inclusive perspective inspires this research to understand what these students feel and think about their inclusion in university settings. The students’ own accounts of their experiences should act as a source for understanding what influences their studies. What I expected to learn from the students was not clear to me beforehand; as I moved from the adaptive perspective into integrative perspective I had no clear idea of what the inclusive perspective meant. This situated my research under what Mackenzie and Knipe (2006) define as the *interpretivist/constructivist* paradigm.

On the other hand, as this research deals with matters of inclusion, it is possible to approach it via the *transformative* paradigm (Mackenzie & Knipe, 2006), since the main objective is to deal with equal and equalising opportunities, approaching social and political changes. However, the function of this confrontation with political and power issues is merely to situate parts of the experiences of the blind students; that is, I will address judgements of value, analyses of power structures or political discourses only to establish the context of these students. Some of these topics were presented in chapters 2 and 3, influencing the social construction of disabilities, legal frameworks and institutionalised discourses as well as matters of discrimination and segregation. But all of these are discussed in terms of student contexts; I do not focus on how to these situations can or should be addressed.

7.1.2. The fieldwork paradigm

Therefore, the expected focus of this research is to work with the students and their experiences, how they perceive themselves and their educational contexts, what they identify as problems in connection with their studies and what they believe requires improvement – based on their routines, their daily lives (Fetterman, 1998) and dreams. I wanted to understand how blind students see their own opportunities for studying, whether there are things they recognise as obstacles for achieving their goals and what they think of the discourses and policies in their educational contexts. I have been inspired by ethnography in my approach to finding the answers to these questions.

More specifically, my approach here is similar to the one described by Ryberg in his doctoral thesis:

> Rather, I would term it a quick and dirty approach which is ethnographically inspired. This type of “quick and dirty” has also been used within workplace studies, HCI studies and by technology designers (Blomberg et al., 1993). I did work with field notes, in-situ interviews, document collection and other ethnographically inspired ways of collecting data [...] (Ryberg, 2007, p.66)

More importantly, in my inspiration from ethnography I adopt a position regarding the subjects involved in the study: They are agents for learning and understanding (Blomberg, Giacomi, Mosher, & Swenton-Wall, 1993). This facilitates an interaction between my culture and their culture, I experience their experiences and try to tell their stories under my reconstructed subjectivity, hoping to have been sufficiently influenced by their beliefs and ways of looking at the world (Corker, 1999). It will be crucial to maintain the perspective of the disabled in the research and not get caught in any specific model of social construction of disabilities (Davis, 2000).

To achieve such an understanding I have used a 'combination of observation, informal interviewing, and participation in the ongoing events' (Blomberg et al., 1993, p.123) of the students.

7.2. Defining the methodology

After having received the above-mentioned feedback from the institute counsellors on the question 'What do blind students need to study systems engineering?', I still felt that the question needed answering, especially as it is linked to other questions:

- Why do faculties need to be prepared to receive blind students, if things are basically covered with a tools package provided by the IBPS? (Hopkins & Eley, 2001)
- Why are blind students reluctant to enrol in computer science career programmes, when there is a great demand for these career programmes from sighted students? (Hopkins & Eley, 2001; Smith et al., 2000)

Therefore, as the number of *how* and *why* questions increased, it became clear to me that I had to explore in more detail what students or potential students thought of them; I chose a qualitative case study approach. In the words of Yin (2003),

> In general, case studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus is on contemporary phenomenon within some real-life context. (Yin, 2003, p.13)

I decided to follow Yin's recommendation. Case studies would be my methodological approach and I would use ethnographic methods in the data gathering process to try to reconstruct blind students' view of their opportunities for studying at university level and ways of dealing with the learning environment. This involves an observation of blind students and their relations with others and their environment. A discussion of Paul Willis' work in Marcus (1986) pointed to the problem of representing the views of groups that one is not a member of:

> "Rather than juxtaposing ethnographic representations of different classes, Willis presents an ethnography of the working class, and just assumes an ethnographic perspective on the middle class by contrast (incidentally, Willis is aware of this problem, as indicated in the above question: "But this cannot be said all at once"). Thus, he makes the lads real, but he chooses to reify the larger system in which they live. This is inconsistent with the spirit of the ethnographic approach he eloquently promotes. What is "the system" for the lads is the other's (the middle class) cultural form. The textual problem here is carefully representing one form of life while caricaturing those of the others beyond it as "the system". (1986, p.186)

Hence, this research will deal with students in their distinct context, focusing on their individual participation and relations with their educational environments, acting as 'the system' (cited in Marcus, 1986). I need to be careful to not just insert the students' views and perspectives into 'the system', as it is necessary to depict the whole picture of the educational environment. On the subject of interviews conducted across cultures, Kvale and Brinkmann (2008) argued that researchers have to ask direct questions to clarify concepts brought up in the interview that are not clear to them. In this particular case, the cultural differences are not merely a result of the fact that the researcher comes from another country and speaks a different language, it is also a result of the fact that the researcher is not blind. Fetterman said that the researcher needs to be aware of identifying the right paths, through 'discrimination, experience, attention to both detail and the larger context, and intuition' (1998, p.92).

7.2.1. Case study

The goal of this research project is to investigate the phenomenon of being a blind informatics student. Such a phenomenon is, as I have explained, not clearly demarcated in the given context; therefore, the methodology suggests that I look for multiple sources of evidence.

In regard to the sub-questions linked to my original main research question, Stake (1995) explains that new questions that substitute or complement the initial research questions will arise naturally in the process. These arise, Stake argues, as part of the interpretation process and the process in which the researcher gains a deeper understanding of the findings and constructs reliable meanings from his/her observations. These meanings are expected to require clarification and, if possible, confirmation or validation.

Creswell (1998) defines a case study as a process in which one gets more and more insight into the phenomenon in question:

> […] a *case study* is an exploration of a “bounded system” or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context. This *bounded system* is bounded by time and space, and it is the *case* being studied – a program, an event, an activity, or individuals. […] *Multiple sources of information* include observations, interviews, audio-visual material, and documents and reports. The *context of the case* involves situating the case within its setting, which may be a physical setting or the social, historical, and/or economic setting for the case. (Creswell, 1998, p.61)

Following this definition, I chose my first case study:[5] a blind student in Denmark studying programming in tertiary education. Based on great involvement with this student I will represent the perspective of blind students and their understanding of the system – both the educational system and the more general societal construction of being blind. However, in order to get closer to identifying inclusion in the School of Informatics in Costa Rica, I will also approach the current ‘system’ in the UNA context.

This will be done via a second case study conducted in Costa Rica through observations and interviews with blind students and a number of

[5] The World Bank: ‘Tertiary education broadly refers to all post-secondary education, including but not limited to universities. Universities are clearly a key part of all tertiary systems, but the diverse and growing set of public and private tertiary institutions in every country – colleges, technical training institutes, community colleges, nursing schools, research laboratories, centers of excellence, distance learning centers, and many more – forms a network of institutions that support the production of the higher-order capacity necessary for development’ ("The World Bank", 2011).

workshops with involved stakeholders (blind students, teachers with and without experience in teaching blind students, disabilities experts and the Office of Disabilities Affairs in UNA).

Both case studies can be defined as instrumental case studies (Stake, 1995, p.3). This implies that I try to understand the phenomena through the cases. I am not interested in why people do things the way they do, but in how this might affect the educational environment. I am primarily interested in their complexity and contextuality (Stake, 1995, p.16), meaning that I want to understand how blind students manage tertiary education, which situations have not yet been overcome, and how do the context, the environment, the peers and the teachers reflect, interact and respond to these situations or how are they prepared to do so. Individual characteristics are useful for illustrating diversity in different situations, but I focus on situations related to the general context. Therefore, I deal with the events or situations that produce new questions or point to areas where it is necessary to take action to create an inclusive environment. Such events or situations are referred to by Stake as ‘issues’ (1995, p.16).

These issues are the ones that should guide the questions and the reorientation of the first research question in order to turn my focus towards the complexity and contextuality of the matter. Doing so I will be able to concentrate my efforts on identifying problems and concerns and how individuals need to face them, providing deep insights into the problems of blind students and how they struggle with and manage these problems and concerns. In this sense, even though I focus on the individuals, the issues intertwined with their ‘political, social, historical and especially personal context’ (Stake, 1995, p.17) are the focus of the study.

Some of these relations could be expected a priori, but others need to be discovered in the form of patterns that describe the relations that surprise us in our fieldwork. Stake calls the task of establishing consistency in these patterns or specific conditions ‘correspondence’. It is when these relations arise that the research questions that orient the constitution of the cases allow new questions, which help us go deeper into our cases, into new issues, into the context that gives meaning to our findings. This process defines the intrinsic role of the researcher as an interpreter (Stake, 1995).

7.2.2. The Danish case study

The process of selecting the Danish case study was simplified by the fact that a limited number of blind students are enrolled in tertiary education in Denmark. Following my interview with the IBPS, I had a list of 15 blind students enrolled in tertiary education in Denmark. None of these students was enrolled in any technological career programme at university level, and only one blind student was enrolled in a technological tertiary study programme in data processing. Thus, I decided to focus on the latter, Marcus (Marcus is as fictional name). The reason why I chose to focus on Marcus in particular was that his career programme shared many similarities with the School of Informatics curricula. The two differed mainly in the degree of detail. I considered extending the case study with some of the other students from the humanities and social science programmes at university level, but eventually decided to focus exclusively on Marcus due to his specific situation and experiences in a technological carrier programme. Finally, this selection was also made in accordance with the principle of extreme cases; even though I could choose other cases from other university career programmes, Marcus was the only blind student in a computer science programme. According to Flyvbjerg (2006), the case selection is important providing that it is important for the 'generalisability' of the study.

> Atypical or extreme cases often reveal more information because they activate more actors and more basic mechanisms in the situation studied. In addition, from both an understanding-oriented and an action-oriented perspective, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur. (Flyvbjerg, 2006, p.425)

In this case, as Marcus was the only blind student in a technological career programme, he became an atypical or extreme case among the other students in his context, but also a unique case if we go even deeper into the relevance of understanding the life experiences of students in technological areas, as he could reveal particularities in the area that would not be present in other areas. Therefore, a student that could describe the difficulties he experienced could clarify a set of the main situations I need to consider in order to propose an improvement in the educational environment for students in the technological areas.

7.2.2.1. The Marcus case

Marcus is a young male, he is between 20 and 25 years old and he has been blind since birth. He revealed that he had been vocationally interested in programming since he was a small boy and, consequently, he decided to prepare himself for such a career. Before he started the programme, he was enrolled in the International Business College, the IBC, to get the mathematics he required and took IT as an A-level subject, obtaining a ‘fine’ grade. He attended the IBPS in Hellerup and then started studying at the IT school in a medium-sized city in Denmark in 2006, where he had lived as a child. He lives alone in an apartment in the centre of the city.

Searching for a case study, I requested the collaboration of the IBPS in September 2007 as I needed to obtain information about blind students in tertiary education in Denmark, including their areas of study. From the list of students I could confirm that there was just one blind student in a computer sciences-related field. I asked the IBPS to contact the student and ensure that I could contact him directly. Marcus accepted unconditionally. My first contact with Marcus was via email in November 2007; we agreed to meet in his place on 5 December. During this visit I had the opportunity to meet Marcus’ girlfriend and a male friend, both of them of similar ages. After the visit, we communicated by email; he told me about some of his experiences and advantages in projects and courses, and I told him about some tools that had been developed in connection with a couple of university projects. On 23 April 2008 we agreed to meet for the second time, again in his apartment, as he preferred it. This time I met another friend who was enrolled in the same school as Marcus. He was slightly older than Marcus. None of Marcus' friends were visually impaired. He was always willing to collaborate and provide as much information as he could. After this second meeting we stayed in touch via Skype, talking about his final project, his concerns about finding a job, his happiness when he got a job and his progress and improvements in that job.

In addition to the visits and the informal communication, my main data gathering tool was interviews, what Kvale calls 'semistructured life world interview' (1996, p.5). Cohen et al. provide a more specific classification based on Patton (1980); they describe four types of interviews, two of which are of interest here: 'informal conversational interview' and 'interview guide approach' (Cohen et al., 2000, p.271). I will discuss these later in this chapter.

7.2.3. The inclusive environment in UNA

After having defined my Danish case study of blind students in tertiary education, I defined a new case study involving a couple of blind students at UNA and teachers. As part of the tools I chose to use workshops. The role of the workshops in this research is twofold; they comprise a tool for gathering information about teachers at the SI at UNA, but they are also an instrument for improving the inclusive environment. In this chapter I will discussed the workshops only as a tool for gathering information. In chapter 9 I will consider their function as an instrument for improving the inclusive environment.

This case study is also an instrumental case study, as I was interested in understanding the other part of the phenomenon of the inclusion of blind students in the UNA context.

7.2.3.1. The students in the Costa Rican case study

My selection of a Costa Rican case study was not more successful than the choice of a Danish case. This was so, because I considered it highly important to find cases located in the UNA.

> One may agree with Dreyfus that intuition is central to identifying paradigmatic cases, but one may disagree that it is a problem to have to justify one's intuitions. Ethnomethodological studies of scientific practice have demonstrated that all variety of such practice relies on taken-for-granted procedures that feel largely intuitive. However, those intuitive decisions are accountable, in the sense of being sensible to other practitioners or often explicable if not immediately sensible. That would frequently seem to be the case with the selection of paradigmatic cases. We may select such cases on the basis of taken-for-granted, intuitive procedures but are often called upon to account for that selection. That account must be sensible to other members of the scholarly communities of which we are part. (Flyvbjerg, 2006, p.427)

Seven blind students were enrolled in the university, but none was following a technological career programme. Following the above conclusion from Flyvbjerg (2006) and the collaboration of the ODA, I selected a case. According to the ODA, the student they recommended was easy to talk to and showed interest in my study, making him an extreme case in the sense that he was recognised by the ODA as the most open student from the list with regard to sharing experiences. He was in his third year, so I expected him to have a good overview of university life, the problems he usually had to struggle with and his interaction with the context. I thus believed that he could provide valuable insight via his relation to the context and the issues concerned.

The second student volunteered; in that sense the only criterion for his inclusion here was his great interest in participating in activities related to his condition.

7.2.3.1.1. Who is Julio?

I will call the chosen case person Julio. As I have mentioned, Julio was in his third year of study. He is male, between 20 and 25 years old. At the age of two, he felt from a hammock and lost vision in one eye and 20 per cent of his vision in the other eye. Then he was diagnosed with congenital glaucoma and as a young adult the disease advanced quickly, blinding him completely in just three months. He was enrolled at the University at Distance (UNED), where he studies theology. When Julio lost his sight completely, he went to the Instituto Helen Keller, where people go to learn specific abilities for coping with blindness: reading Braille, type writing, using screen readers (Jaws in this case) and moving around with a stick. His time at the institute encouraged him to continue his studies and he decided to change to 'Orientación', a career programme that focuses on student counselling, vocational orientation, interpersonal relationships in families and companies. He migrated from a medium-sized city in the country, located 70 kilometres from the capital and 85 kilometres from the UNA, to attend university. He lives alone in a hall of residence. He comes from a low-income family.

I first contacted Julio after the ODA had talked to him, asking for authorisation. I coordinated my contact with him from Denmark, using emails and telephone calls. We met for the first time on 4 June 2008 at the university, 30 minutes before one of his classes. We arranged to meet in front of the ODA office and I approached him, having guessed that the young man accompanied by a guide dog was Julio. He walked with determination and presence, somehow legitimising his belonging to this environment. During the 30 minutes I made my formal introduction and explained my expectations to my work with him. I gave him the statement of disclosure and informed consent and got his formal consent that I could join and observe him in his next class. This had already been coordinated with Julio and his teacher. Then I confirmed that I would be observing another class on 6 June; this had also been agreed upon in advance by both Julio and his teacher. After the second class observation we met to talk about his experiences at university. I have kept sporadic contact with Julio by email with brief follow-ups about his career progress.

7.2.3.1.2. Who is Vicente?

Vicente is also a pseudonym used to protect the identity of the participant. He is also a student in UNA in counselling. He is in his last year. As he was not formally introduced, I have few details about his background and life story. He lost his sight very early due to congenital glaucoma and lives in a big city near the capital. He is very introvert and quiet.

Vicente joined Julio and me when we had arranged to meet to conduct a interview. He heard about the interview and asked me if he could participate. I accepted with Julio's approval. Then I informed Vicente of the time and place for the meeting, he excused himself, because he had a class at the agreed upon time, but he asked if he could join us later, and so he did. As soon as he joined us I read the non-disclosure agreement to him; I made sure he understood the agreement, and the recorder was used to register his approval.

7.2.3.2. The case study workshops in Costa Rica

In fact, as participation in the workshops was voluntary, the first issue that was brought up was: Who was interested in the activity and why? The other issue related to this activity was the fact that the school received a request from a blind student some years previous who wanted to enrol in the system engineering career programme. However, in the end the student decided not to enter the School of Informatics. I was curious as to how this event had affected the teachers. In general, though, the main goal was to go deeper into parts of 'the system'. It was important to understand the teachers' view of blindness and, eventually, how they could see themselves teaching blind students.

The activity was planned as a sequence of four workshops; the teachers were to participate in only three of them: the first, the second and the final workshop. The workshops were planned with different activities with the objective of moving the participants towards the economic model and an inclusive perspective, as defined in chapters 2 and 3, respectively.

The ODA was invited to participate in the planning of the workshops and to act as facilitators in the workshops. Their participation was limited, but valuable, especially in comments about the lexicon used in the context, providing information of possible participants from other academic units and locating students. The ODA participated in the first two workshops and they declined my invitation to function as facilitators.

N	Name of the workshop	Participant group	Date
1	Viviendo entre luces y sombras (Living among lights and shadows)	ODA Teachers SI Researcher/facilitator	9 June 2008 14:00-18:00
2	Aprendiendo con otra percepción (Learning with another perception)	ODA and Teachers SI Blind Students – UNA Experienced teachers – UNA Researcher/facilitator	11June 2008 14:00-18:00
3	Soñando con el futuro (Dreaming of the future)	Blind Students – UNA Researcher/facilitator	13 June 2008 08:00-12:00
4	Obteniendo soluciones (Getting solutions)	Teachers SI Experienced teachers – UNA Researcher/facilitator	16 June 2008 14:00-18:00

Table 7.1. Participant groups in the UNA workshops.

The structure of the workshops also depended on the participation in the second and forth workshops of teachers with previous experience from other academic units. Blind students from UNA participated in the second and third workshops. Table 7.1 lists the workshop headlines, dates and groups of participants in each of the three workshops. Table 7.2 lists the fictitious names of each of the members in the groups involved in the workshops. Julio and Vicente are the two students involved as explicit parts of the case study in Costa Rica.

The third workshop was not a part of the case study, but a supplement to the other workshops, working as a tool for fostering inclusion. It has the format of a future workshop (Apel, 2004; Brooks-Harris & Stock-Ward, 1999) (see Table 7.1). I will explain this in detail later in the chapter.

Participant groups	Pseudonym	Gender
Group 1. Blind students	Julio	M
	Ernesto	M
	Vicente	M
	Patricia	F
Group 2. Teachers from the School of Informatics (Teacher SI)	Julia	F
	Isabel	F
	Gabriel	M
	Marcela	F
	Sofia	F
	Joaquin	M
	Claudia	F
Group 3. Experienced teachers	Adolfo	M
Group 4. The Office of Disabilities Affaires (ODA)	Sara	F

Table 7.2. Members of the UNA workshop groups.

The four groups of participants observed the following:

- The first group of participants, the students (Group 1), consisted of four blind students from different career programmes at UNA. Three of them were enrolled in the counselling career programme to support students in areas where guidance was required; this did not necessarily involve academic problems. The fourth student in the group was enrolled in philosophy.
- The second group, the IS teachers (Group 2), consisted of seven teachers from IS; six of them are fulltime teachers with a background in system engineering or educational informatics. The seventh teacher has a background in special education and previous experience with blind students and is employed as a

part-time teacher in the school's Educational Informatics Master Programme.

- The third group, experienced teachers (Group 3), should consist of teachers from UNA with previous experience with blind students. The ODA was in charge of locating these participants, but was not very successful. Thus, I took over the list of teachers one week before the workshops were scheduled to begin and I was able to recruit only one teacher from the International Relationships career programme. He taught a blind student in one semester and was a deputy and member of the commission of the Asamblea Legislativa (the Costa Rican Legislative Assembly) in charge of studying and approving the Law 7600, establishing equal opportunities for people with disabilities (Costa Rica., 1996).
- Additionally, the UNA Office of Disabilities Affairs (UNA Educación de Calidad para Todos – UNA-ECT or Group 4) participated in part in two workshops. At the beginning, I worked with them as a collaborative team preparing the workshops, taking into account that they had to have experience dealing with UNA students with disabilities. The idea was to work together, trying to capitalise their experience in the design of a tool that other schools could use in the future to prepare themselves to receive blind students. In the end, UNA-ECT participated as a marginality, drawing on Wenger, a form of non-participation (Wenger, 1998). It is not the intention of this research to focus on the reason for this kind of participation or non-participation of the office specialised in the area of inclusion. This non-participation was not only manifest in the office's refusal to act as a facilitator in three of the four workshops, but also in their refusal to participate in the entire session of the two workshops they did attend.

Additionally, in the first two workshops an assistant from the ODA helped me take notes, and two students from the SI volunteered to help video record the four workshops.

7.2.4. Methods for constructing data

I was inspired by Kanstrup's thesis (2005) which revealed how, when doing qualitative research, the researcher is immersed in the context of his or her cases, clarifying that tools should act as a guide for structuring the data gathering process, not limiting it.

> I find it difficult to put a label on the type of observation that I have conducted during this study. I have observed the work of the local IT-supporter by following him during his working days at three visits where my observation method primarily has been to follow "the natural stream of everyday life" as described above by Adler and Adler. In this way, my participation has not been intense in the sense that I have not been an included participant but a visitor, and I have not been part of planning the day but have followed the routine or work carried out by the participants. However, I have not just observed (which I believe is impossible). I have participated in discussions during breaks, sometimes in working situations and in interviews. Through this, I have affected the participants just as they have affected me. (2005, p.71)

According to Geertz (1973), the phenomena we want to understand are usually manifested in the context, in the background, even before we really get directly involved with it. Therefore, he states, our data is really 'our own constructions of other people's constructions of what they and their compatriots are up to' (Geertz, 1973, p.9).

> There is nothing particularly wrong with this, and it is in any case inevitable. But it does lead to a view of anthropological research as rather more of an observational and rather less of an interpretive activity than it really is. Right down at the factual base, the hard rock, insofar as there is any, of the whole enterprise, we are already explicating: and worse, explicating explications. (Geertz, 1973, p.9)

In this sense, I felt more comfortable with constructing the data in this way, because according to Stake,

> It would be good if we could get what we need by observation alone. But often we have too little time and have to rely on what others have seen. And sometimes we do care about the comments the interviewees makes. So we interview. But it is usually so much better if we can see it ourselves. (Stake, 1995, p.66-67)

I agree with the relevance of the observations as sources of data, but this process is often ‘contaminated’ with the mere presence of the observer. Following Kanstrup (2005), being present in the context in question, observing, can be intrusive, and one can easily end up influencing the context. But also, as an observer, you will still receive many comments and information from the people around you, even though you have not asked for it. If the people who are being observed share something from their own experiences, we as observers need to rely on it to the same extent as if it was an answer to an interview question. Therefore, being an observer and relying on this activity only in gathering data might be a ‘cleaner’ or less tainted way of doing ethnography; still it is unlikely that one can fully avoid the collateral effects discussed. And, of course, as Stake has said, time is often against the projects and sometimes I think taking shortcuts is comprehensible and necessary in order to achieve one’s goals within a reasonable time.

Also, I am conscious of the difference between the observations and the interview itself. In the words of Stake:

> What is observed usually is not controlled by the researchers, they go to where things are happening, with the hope that as they would have happened had the researchers not been there. What is covered by the interview is targeted and influenced by the interviewers. (Stake, 1995, p.66)

Even more so, observation ‘is considered to be able to provide more valid data about social processes than some other data collection strategies’ (Timmerman et al., 2001), due to the fact that it ‘affords the researcher the opportunity to gather “live” data from “live” situations’ (Cohen et al., 2000, p.305).

Furthermore, other considerations can limit our opportunities to gather data from observations exclusively. Some of these considerations arose in my Danish case study:

- Marcus was a bit reluctant to allow me to visit his school to observe him in his primary learning environment.
- There was a language barrier, due to my limited ability to speak and comprehend Danish, which is the native and natural language in Marcus' educational context.

Hence, I relied more on interviews and complementing them by direct observations in his home and during leisure activities with close friends. Some of the most relevant information I got from this first interview came from direct observation: Marcus' obvious passion for computers, seeing his collection of three or four or more laptops and how he used them, almost giving them their own personality. I soon learned that his context was under control. By that I do not mean that everything in his flat was impeccably organised, though; in fact, he had the same trouble locating things than sighted persons. Suddenly, I realised that I was interviewing a student who was sharing his experiences of the school, complaining about imperfections in the department, about the teachers and the tools they still used there. Also he had a thirst for knowledge. He wanted to ask me technical questions as soon as he realised that I would be able to answer them as a professional in computer sciences. He was eager, like all technicians, to show me all the things he had been doing, like a soldier with his medals. Most of these things were not discussed in the interview, but they were grasped from the context.

7.2.4.1. Interviews

Along the same line of analysis, the interview was audio recorded, even though Stake does not recommend it, except if the interviewer is expected to produce an audio presentation of his or her results (1995). Also, he notes the low value of having a transcription of an interview and the even lower value of a literal reproduction, word for word. Stake argues that this activity is very time-consuming, diverting the attention of the researcher away from other more valuable activities, and it is not useful to send transcripts back to the respondents who usually do not recognise themselves in the transcript due to the difference in the oral and the written vocabulary. This is also so, because it takes too long before it is available; the ‘context and innuendo have slipped away’ (Stake, 1995, p.66).

Regardless of this recommendation, I did a full, though not literal transcription of all the interviews of the student cases and of parts of the workshops. In the case of Marcus such a transcription had a particular value as a way of ensuring reliability in the construction of the data, because in this interview I really struggled: English was a second language for both of us and, in addition, Marcus spoke too fast (Kvale & Brinkmann, 2008). In order to ensure consistency in the treatment of the information, I also transcribed the Julio and Vicente interview that was conducted in my mother tongue. This produced another tension, because part of this interview required a translation from Spanish into English. This meant that I had to be particularly careful to maintain the contextual meaning of the interview, not only in the transcription, but also in the translation (Kvale & Brinkmann, 2008).

On the other hand, Kvale (1996) has stated that today interviews are seldom analysed from the recording directly (notice that this reference is from 1996; when compared to Stake [1995] this seems like a matter of diverging opinions rather than a historical tendency). Consequently, he says, most analyses are done using written transcriptions from recordings, at the same time recognising the limitations of this practice, since transcripts are not ‘the rock-bottom data of the interview’ (Kvale, 1996, p.163). This also involves reliability and validity considerations. This will be discussed later in this chapter.

To summarise, what matters, methodologically speaking, is not whether I did a literal transcription or based my analysis on the recordings. What matters is keeping the flow of the interview and grasping the meaning of what the students say, keeping my mind open to the little details that can make all the difference. In fact, as a result of the kind of interview conducted, such reflection was present throughout.

Recalling the four types of interviews described by Patton (1980 cited in Cohen et al., 2000), the two interviews conducted with Marcus and the interview with Julio and Vicente correspond to type one: informal conversational interview. I will recognise that the first interview with Marcus was prepared with a guide approach, which would correspond to type two, but the guide was soon set aside by the fluent dialogue which turned the interview into a more informal conversation, with great richness (see table 7.3 for the Patton description).

If we use Fetterman's classification of structured, semi-structured, informal and retrospective interviews (1998), the three interviews are informal, and they are located in between Patton types one and two, because they are identified as casual conversations, which corresponds to in type one, and because there is 'a specific but implicit research agenda' (1998, p.38), which corresponds to type two. Informal interviews are used extensively in ethnographic studies as a means of discovering the interviewees' thoughts, experiences and understanding of different phenomena (1998).

Type of interview		Characteristics
1	Informal conversational interview	Questions emerge from the immediate context and are asked in the natural course of things; there is no predetermination of question topics or wording.
2	Interview guide approach	Topics and issues to be covered are specified in advance, in outline form; interviewer decides sequence and working of questions in the course of the interview.
3	Standardized open-ended interviews	The exact wording and sequence of questions are determined in advance. All interviewees are asked the same basic questions in the same order.

4	Closed quantitative interviews	Questions and response categories are determined in advance. Responses are fixed; respondent chooses from among these fixed responses.
(Taken from (Patton, 1980) Cohen et al., 2000, p.271)		

Table 7.3. Types of interviews according to Patton.

If we refer to Kvale (1996), especially the first interview with Marcus resembles an ethnographic interview, as a semi-structured guide was used to support the interview.

The interview with Rosa, a 32-year-old former student at Aalborg University mentioned in the beginning of this chapter, was a type two, following Patton (1980 cited in Cohen et al., 2000), and semi-structured, following Fetterman (1998).

Other interviews were conducted (see table 7.4), corresponding mostly to Patton's types two and three, but they are used as additional sources and will not be analysed, only referred to as complementary information:

Name or organization	Role	Description
Rosa (pseudonym)	Former student at AAU/Currently employed at AAU	Sharing experiences about her blindness and the impact on her studies
Pia Penderson	Former student at AAU/Currently employed at AAU	Sharing experiences about how she manages her mobility impairment
Kistian Olesen	Head of the Department of Computer Sciences, AAU	Interview about the readiness of the department to receive blind students
Institute for Blind and Partially Sighted	Counsellor for blind students	To understand the role of the institute and the kind of support they provide

Elizabeth Gonzalez	Head of the School of Informatics, UNA	Her view of the inclusion process in the School of Informatics
Angélica Fontana	Coordinator of the ODA, UNA	To understand the role of the office and the kind of support they provide
Martha Gross	Counselling of blind students, Office of Disabilities Affairs in Universidad de Costa Rica	To understand the role of the office and the kind of support they provide
Karina	Student of communications in Universidad de Costa Rica	Sharing experiences about how she manages her blindness and her work in graphical environments

Table 7.4. List of other interviews conducted.

7.2.4.2. Observations, workshops … and observations

In addition to the interviews direct observations and workshops were conducted as tools for gathering information. In this section I will describe both tools.

7.2.4.2.1. Direct observations

As part of the data construction work in connection with the Costa Rican case study, I observed Julio in class during two different courses. This was something I had missed in relation to Marcus due to language limitations. In the first lesson the students had to present their group work. As part of the activity of Marcus' group, an invited lecturer participated in the class. In this space I concentrated my attention on Julio's role and his interaction in the class. Then his group made their presentation in front of the class.

The following day I observed the second class, where another invited lecturer participated. Coincidentally, another blind student was in the same class (Vicente). As I had previous authorisation from Julio, I asked Vicente if I could video record him. The video recording made it possible for me to get a glimpse of their educational practice. However, as I was only present for a couple of hours, with a very visible camera and with no permission to focus on other students, I can just say that this was an intrusive observation of the students in their educational context (Jordan & Henderson, 1995). However, these glimpses of the educational situation were very valuable, giving me some insights which I could refer to in the following interviews.

As stated in the beginning, I have focused more on doing interviews, and I have used informal observations primarily as a way to get some insights into the context in question. Many more observations were done in the workshops, explained in the following section.

7.2.4.2.2. The workshops

In contrast, a formal observation was done in the four workshops mentioned above. I had a number of roles: I was the organiser and facilitator of the workshops in addition to my role as researcher. I was what Cohen, Manion, and Morrison (2000) call a 'complete participant'.

In fact, my role as organizer started in Denmark. Firstly, understanding that there can be some practical limitations in organising workshops from a distance and, secondly, knowing about the role of the ODA, I tried to involve this office in the preparation of these activities. I asked them to work with the general framework I had prepared and evaluate whether it would be useful for their future work. Unfortunately, they soon lost interest and their participation was limited to lexicon corrections and locating blind students and teachers who had previous experience with teaching blind students. In both cases, I had to contact all of them directly, by email or by phone, myself.

As facilitator I faced a greater challenge. Brooks-Harris and Stock-Ward (1999) define the role of the facilitator as follows:

> A workshop facilitator can stretch beyond the expert role by also encouraging learning between and among the participants, as well as through participatory experience. This expanded role can be more effective because it promotes learning on many different levels. The role of

> creating powerful learning experiences and guiding and encouraging personal and interpersonal learning can create change that complements and creates greater and deeper learning than merely providing information. (Brooks-Harris & Stock-Ward, 1999, p.7)

Valqui Vidal (2006) is more precise when it comes to the facilitator's role. He lists five functions which a facilitator must oversee:

> 1. Focus: to provide a focus for the group.
> 2. Stimulate: to encourage constructive debate between the participants
> 3. Support: to bring out information from introverted participants and to allow new ideas to be submitted.
> 4. Participate: when the group is interacting poorly or is going in the wrong direction, the facilitator must be willing to promote new discussions.
> 5. Team building: to form a cohesive, interactive, dynamic and creative group. (2006, p.3 Chap.3)

Indeed, the first, second and forth workshops were designed with the clear objective of being an experiential learning activity, creating scenarios via which the participants could share experiences and life stories, thus producing the knowledge needed to understand and improve inclusive stages in educational environments. In this sense, my role as facilitator included, creating a setting for the participants to explore and exchange experiences and offering useful activities that would motivate the participants to experience new sensations and to reflect on them. After these activities, there was time and space for conceptualising the experiences and getting ready to go back to experiments. In principle, this corresponds to the Kolb 'Experiential Learning Cycle' (Kolb, 1984 cited in Brooks-Harris & Stock-Ward, 1999).

The activities were designed to reduce my role as facilitator as much as possible in order to maximise my availability as an observer and researcher. In order to support this role a voluntary student from the SI helped me with the audio and video recordings. I prepared some material that allowed me to keep evidences of the progress of the workshops, using permanent tools to register the work of the groups. The workshops have played an important role in this research as a tool for collecting data about institutional issues, teachers' views and the educational practices of blind students. If it had been possible to have two different persons act as facilitator and researcher, respectively, the latter should have been a participant observer (Fetterman, 1998). This was not possible, however, and I functioned both as researcher and as interviewer. The format of the workshops was established beforehand, causing the workshops to work as semi-structured interviews (Mason, 2002).

As the workshops were used as tools for researching purposes, it was relevant to inform the participants formally about this double objective, and they were asked to sign a statement of disclosure and informed consent (Fetterman, 1998; Kvale, 1996; Kvale & Brinkmann, 2008; Ritchie & Lewis, 2003).

Also, three of the workshops (numbers one, two and four) were designed with the objective of making the participants reflect on different social constructions of blindness and moving their views in the direction of the economic model and an inclusive perspective. Brooks-Harris and Stock-Ward (1999) define workshops as:

> […] environments for learning to occur in a dynamic and powerful manner. The workshop format can be used to promote personal growth, teach professional skills, or create change within existing systems. Workshops provide an effective short-term training method that can be used in a wide array of settings with an infinite number of topics. Because of their duration, workshops are flexible and cost-effective; they can be easily designed or modified to meet the needs of different groups and organizations. This adaptability to a particular group and topic can be employed to capture the motivation of learners and to enhance the opportunity for long-term change. (1999, p.1)

This description of workshops is very much in line with the aim of my workshop design here. One of my premises was that I wanted an effective tool for collecting data to support the workshops, promoting personal growth, professional development for the teachers of the SI and eventually from other academic units and to provoke changes in people's views and efforts to create better opportunities for blind people. Furthermore, I was interested in whether the workshops could serve as training workshops, which all teachers and administrative staff dealing with blind students could participate in. Due to the tight schedule of the teachers who participated, the workshops had to be conducted in a very efficient manner. In the last workshop I discussed the most relevant observations from the previous workshops with the participants to get their feedback on the process and to evaluate the effectiveness of the developed tool. The three workshops (the first, second and forth) will be discussed in detail in chapter 9.

7.2.4.2.3. The future workshop

For the third workshop I used a specific type of workshop, called the 'future workshop'. The aim of this type of workshop is to 'change or transform the actual situation of a system' (Valqui Vidal, 2006, p.2 Chap.6).

A future workshop (FW) is a tool that is developed and discussed by Jungk and Müller (1988), who have inspired others (Apel, 2004; Valqui Vidal, 2006). The workshop format has been standardised and consists of five typical phases:

1. The preparation phase: Here the themes, the invited participants, the methods, their rules and the time table of the workshop are settle by the organizers of the workshop and the facilitators. The room and local facilities for the workshop are settled.
2. The critique phase: Here the problem is critically and thoroughly discussed and investigated. Brainstorming is the preferred creative technique

follow up by a structuring and grouping of ideas in some main sub-themes.

3. The fantasy phase: Here the participants try to work a utopia, to draw an exaggerated picture of the future. Brainstorming and other creative technique might be used. The social fantasies of the participants are developed in this phase.
4. The implementation phase: Here the ideas found are checked and evaluated in what concerns their practicability. An action plan is elaborated.
5. The follow-up phase: Here the action plan is monitored; eventually changes are performed and if needed new FW's are planned. (Valqui Vidal, 2006, p.5 Chap.6)

The objective of this workshop was to give the blind students an opportunity to dream about solutions for academia, without restricting other areas. From the dreams I expected to learn, albeit indirectly, about their experiences and priorities. In addition, I was looking for something that might be significant for their identities, their memberships or multi-memberships, their trajectories, their negotiability within and with other communities and experiences.

The design of the workshop was adjusted to this specific purpose. As I did not intend to change a system, the fifth phase was purposeless and was therefore cancelled. Also, the critique phase was adjusted. This phase was called 'Pintando mi realidad' ('Drawing my reality') and students were requested to bring to the session a list of difficulties they had to face; the idea of this 'homework' was simply to leave more time for 'dreaming'. The students were given a list of inspirational topics they could refer to:

- Coping with the classroom, regular academic activities, examinations etc.
- Working in groups, labs, workshops.
- Coping with the academic and pedagogical environments.
- Using tools.

- Any other academic activities.

The list had to be sorted to highlight the three most significant difficulties for each student, which had to be presented to the rest of the group.

Here it was necessary to insist that the students should neither construct new difficulties nor describe awful situations that might happen or only happened rarely. Instead, they were instructed to focus on listing the difficulties they faced daily in the academic environment, the difficulties that comprised ‘a small stone in their shoe’.

> From the learning psychology’s point of view, all the critique and sinking into difficulties may surely have a demotivating effect. (Apel, 2004, p.9)

In this sense, it is essential to try to keep the motivation high and thus facilitate ‘dreaming’. Therefore, it was important for me to define ‘the “critique phase” as the “problem-finding phase”’ (Apel, 2004).

‘A soñar …’ (‘Let us go to dream …’) was the name of the next phase, corresponding to the fantasy phase. Here the students were invited to dream about their ideal forms of support. Using the list from the previous phase as an inspiration, they were instructed to think about solutions or tools that could help them overcome these difficulties, without limitations in terms of availability, cost or feasibility. Even though the goal of the activity was to focus on solutions for the academic environment, no limits were imposed. I wanted to register any dream they might have, as a reflection of their needs, probably undetected by themselves.

This is perhaps the most important activity in the entire set of workshops, and one of the most difficult activities as well. Apel remarks on this phase:

> It is doubtful, if a group of participants can be transferred into a state of overflowing ideas on command or merely by methodical tricks. Even creative techniques have limits. Much depends on the general atmosphere and also on a relaxed and easy-going moderator. Frequently, the participants lack the courage to abstract from inherent

> necessities. Anything that is produced in the fantasy phase might already exist in reality. If it is possible to free the group or the individual persons from any inhibitions or blocks so that they can develop a undisturbed “normal” group productivity, the workshop can be called successful. (Apel, 2004, p.8,9)

So, this phase does not only depend on the previous phases, it also depends on the individuals, the empathy between the facilitator and the audience, and the environment that can be constructed in the precise moment to trigger the phase, especially after dealing with the critique phase.

The last phase was designed to transform the solutions to reality, and it was called ‘Dando pasos firmes. ¿Qué es posible desarrollar?’ (‘Stepping firmly. What is it possible to develop?’)

In this phase I wanted to bring them back to their own construction of the world, to understand their own reality and how it was constructed. I wanted to see the students select the most relevant dream or determine how hopeful they were about finding solutions to the different situations that motivated them to list that specific dream. It could be difficult to separate these two aspects of a given dream, but in either case both conclusions are interesting.

Therefore, as this workshop was based on the feelings, thoughts and perceptions of the participants, its flow was crucial with regard to keeping the process clear, transparent, as free of contamination as possible, because:

> The stimulating role of the moderator whenever the critique, the ideas or the evaluation of strategies are stagnating, is a tight rope walk between mental support and manipulation. (Apel, 2004, p.9)

Unfortunately, the workshop was delayed, as the students were delayed; therefore, I was forced to skip this phase in order to make time for the last activity.

The workshop closed with conclusions about the discussion, how the students felt about dreaming and their opinions with regard to the initiative in general. From a research point of view the workshop provided insights into the dreams of the students and a list of their wishes.

7.2.5. How the data is analysed

I have described the different sources of data used in this research. The data is registered in several different formats, and the most relevant information was transcribed from video and voice recordings. Now the challenge is to arrange this data, which include large amounts of information, to analyse them systematically and generate stories that can help us understand the phenomena under study.

Yin (2009) recommends that researchers who are faced with the challenge of finding an analysis strategy start with playing with the data. He presents a set of analytic manipulations described and summarised by Miles and Huberman (1994 cited in Yin, 2009). From this set I have chosen to make ‘a matrix of categories and placed the evidence within such categories’ (2009, p.129). He states that such manipulation does not guarantee that one finds a general strategy, but if so it can save the researcher a lot of time. One of the four strategies that Yin propose is ‘Relying on theoretical propositions’ (Yin, 2009, p.130). This means that you can let theoretical propositions guide your analysis. These guides would make it easier to separate the data of interest from the rest (2009).After defining the general strategy, there are different analytic techniques. ‘Explanation Building’ is one of them, establishing as its goal ‘to analyze the case study data by building an explanation about the case’ (2009, p.141). Such explanation building often results in a narrative form that is expected to generate significant propositions from the used theory.

On the other hand, Stake suggests that researchers analyse their data using two strategies: ‘categorical aggregation’ and ‘direct interpretation’ (1995, p.74). According to Creswell:

> In *categorical aggregation*, the researcher seeks a collection of instances from the data, hoping that issue-relevant

> meaning will emerge. In *direct interpretation*, on the other hand, the case study researcher look at a single instance and draws meaning from it without looking for multiple instances. It is a process of pulling the data apart and putting them back together in more meaningful ways. Also, the researcher establishes *patterns* and looks for a *correspondence* between two or more categories. (1998, p.154)

In fact, in the data analysis the researcher who had conducted case studies need to follow both lines. In some situations data will offer guidance that one needs to followed, as a sequence of issues that can end in the achievement of 'intuitive aggregation' (Stake, 1995). This is the most common situation when researchers deal with instrumental cases; still, researchers might face events or activities that appear just once, but which, on account of the importance hereof, need to be interpreted directly (1995).

Kvale classifies this approach as an 'ad-hoc approach': a mix of approaches are used, as a merger of 'categorization' and 'interpretation' (1996, p.191).

When the data have been organised and processed in meaningful ways, the next step is to develop naturalistic generalisations (Stake, 1995, p.85). It is from this generalisation that readers can learn from the case in question, and when it becomes familiar to them, they will add their interpretation to the rest of the known cases, enriching the group, facilitating new generalisations and modifying the old (1995).

Indeed, on the basis of my large set of data, collected from extended interviews, workshops and direct observations, all of them ethnographically inspired, I started to focus on the interviews with the students as key actors. As Yin (2009) has suggested, I started to play with this data. Starting with the transcriptions and then re-reading them in the original language, I made a first selection of students' comments which I found relevant, informing me of their thoughts and feelings. The list was still too long. Then I recognised that the data reflected the theory and that I could rely on theoretical propositions in categorising them. As I was using ‘instrumental cases’ to construct data about the phenomenon and this data contained a rich variety of elements for discussion, I was dealing with ‘categorical data’, concentrating on their relation with my research interest. Table 7.5 offers a list which I have used to guide the data categorisation work. This list is basically a result of the theory discussed in chapter 6 and concepts from chapter 2 on blindness theory. I should highlight that the concepts included in this list have arisen from the data; that is, the theory was not used to find all the theory concepts in the data. Therefore, some topics from the theory, which were not present in the data, have not been included in this list.

Theoretical propositions for categorising data
Coping with learning
Practice of inclusiveness
Social structures
Identity in practice
Identity
Skills
Information
Tools
Engagement
Imagination
Alignment
Negotiation of meanings
Participation/non-participation
Marginality
Peripherally
Outsider
Multi-membership
Styles and discourses of broader constellations
Boundaries

Boundary object
Discrimination
Prejudges

Table 7.5. List of categories inspired by the theory.

With this classification I have built a matrix for organising the data. In many cases the students' comments have been repeated, as they fit into different categories at the same time. With these categories it was possible to detect comments that might be ignored in the analysis if considered outside the context; as they appeared repeatedly, it established some aggregations in the collection of data. An example of such an aggregation was when Marcus complained several times about his peers' abilities, identifying a specific situation which needed to be included in the analysis. Also the aggregations occurred when events described the same evidence, as they were mentioned by all the students; an example hereof was that the teachers failed to provide the class material in advance and in accessible formats.

Additionally, it was necessary to include valuable information from other sources, but as I have already defined specific categories, it was easier to introduce observations, other data gathered from other interviews that were not transcribed and relevant student comments during the workshops; all of them responding to the same categorisation. Some of these data came from direct interpretation, such as the event in the class that both Costa Rican students attended, where the teacher, despite having mentioned the relevance of inclusion, presented only visually oriented material in class. This event established a direct interpretation, which will be discussed in chapter 8.

Once the data had been gathered and the transcriptions and the material generated, I repeated the process on the basis of the information I had obtained, in particular the information I had obtained from the participant teachers and their interaction with the students and the other participants. In this case, another matrix was generated, using the same categories and the same process to discuss the events and findings.

This organisation allowed me, in the construction of the narrative, to present the data in a structured format in two different chapters, maintaining the separation used in this first analysis. Thus, in chapter 8 I present the students' stories, organised according to the guidance provided by the theory, though not submitted to it. Section 9.2 contains an equivalent story from the teachers who participated in the workshops, following mostly the same guide as the students' story. From these stories I continued to the last step in the analysis, what Stake calls researcher's 'propositional generalizations' or 'assertions', generating naturalistic generalisations as a 'translation from the experiential language to formal language' (1995, p.86). In this case the formal language is associated with specific theories used to complement the experiences; that is, even if it may distort the meaning of the stories, it is important, because it facilitates 'the embeddedness in the experience of the reader, whether verbalized or not' (1995, p.86). This last step of the analysis is presented in chapter 10, where I have compiled the stories in order to translate them into a single story, written in formal language, submitted to the theories that support the research.

7.2.6. Ethical considerations

Previous studies have revealed the importance that blind people in particular give to researchers' comprehension of their reality. With slogans like 'we know best' (Duckett & Pratt, 2001) and 'nothing about us without us' (Charlton, 2000), they demand that people respect their rights, 'tap into that existing expertise, rather than to try and generate new knowledge' (Duckett & Pratt, 2001, p.828) and:

- respect people's individuality;
- have a practical focus and be action orientated;
- to contribute to furthering an empowering and emancipatory research agenda (2001, p.829)

Moreover, as this research is ethnographically inspired, the rights of the participants have to be observed and formally considered (Fetterman, 1998).

Then the proposal was designed, considering the available resources and the contextual conditions, canalising the efforts into compiling the required data to provide valid and documented conclusions. It is in this preparation work, in the previous interviews and with the literature review that the scope of the research can be defined, to determine where the raw data can be found and the conditions for a proper analysis of this body data (Fetterman, 1998).

Therefore, my preparation for the fieldwork involved other ethical considerations regarding the identification of key actors and informants and the schedule for working with them. Participation in this research project was voluntarily, and the individuals selected were contacted for the specific purpose of this research. In that sense, there are no conflicts in connection with the participants, as they were all eager to participate. Contact with them was established in advance and the respective settings were prepared (Fetterman, 1998). Vicente, the second student participating in the interviews in Costa Rica, was excluded from these advance arrangements, as he turned up on his own initiative, showing great interest in participating in the interview with Julio.

Even though participation was voluntary I wanted the formal consent of the students who were interviewed and the teachers who participated in the workshops. Three different documents were prepared in both languages (English in the Danish case and Spanish in the Costa Rican cases). In Spanish there are two different documents for the interviewed students and the workshops participants, respectively. Via these documents I informed and ensured that the participants understood the objective of the research, the purpose of their participation, who I was, that the interviews and workshops would be video and audio recorded and photographed and that the images would be used in research reports as illustration (Fetterman, 1998; Kvale, 1996; Kvale & Brinkmann, 2008; Ritchie & Lewis, 2003). In these informed consent documents the participants were also informed of their right to withdraw from the study at any time without any kind of pressure, repercussions and questioning. They were offered anonymity, and each participant would be referred to under a pseudonym. Furthermore, they were warned that:

> You must consider that due to the particular situation of the students and the small population in these circumstances, it could be difficult to guarantee the total anonymity of the student. (Appendix A)

As the students had difficulties signing the documents, they preferred to give their consent orally. This was recorded.

During the interviews the researcher was open to any questions the interviewees might have about the study, about experiences in other contexts, about professional skills and so on. Some personal questions concerning my situation as a student in Denmark were even allowed. With honesty and non-technical language the interviewees trusted the researcher, achieving a relaxed environment for interaction (Fetterman, 1998). However, other questions were more complex as they included personal and professional criteria in situations that concerned the students. For example, Marcus wanted to validate some topics that had not been fully covered by his former teacher, thus taking advantage of the researcher's professional knowledge. Following the same honesty principle (Kvale & Brinkmann, 2008), the researcher answered technical questions without adding values about the situation or commenting on the teachers' actions. This part of the interview was used in the research to evaluate Marcus' situation, not the teacher.

A similar situation arose later when Marcus asked the researcher of his opinion about which of two projects Marcus should choose as his final project. The two projects involved two different student roles, and it was possible to identify one potential difficulty in his preferred project. The difficulty was related to his condition. Rather than try to influence Marcus to choose the other project, the researcher answered the question, providing pros and cons in connection with each project, focusing on technical matters, but including in this list the possible difficulty detected. The researcher thereby left it to Marcus to determine which project was the best, without involving Marcus' condition in the decision.

These are explicit examples of situations in which the researcher needs to take a step back to avoid being too involved with the interviewee, to be unobtrusive (Fetterman, 1998). This is especially important because the researcher is likely to be unaware of many important and relevant facts. As the researcher was considered an academic authority in computer sciences, and simply in his position of interviewer (Kvale & Brinkmann, 2008), his comments could had a significant affect, more than that of a simple opinion.

Following these considerations, a rigorous work accompanied this research to close the cycle of ethical considerations.

7.3. Qualitative criteria

The same considerations need to be taken into account in qualitative research as in quantitative research, but the criteria differ. Kvale calls these considerations ‘The Trinity of Generalizability, Reliability, and Validity’ (1996, p.229). From the perspective of social sciences, such concepts have a broad spectrum of definitions (Kvale, 1996; Kvale & Brinkmann, 2008) and an even wider spectrum if we include positivist researchers (Cohen et al., 2000).

7.3.1. Generalizability

Talking about case studies the spectrum of some of these definitions is more limited and new understandings of these criteria are generated. For instance, the generalizability concept is understood not as the process of generating knowledge from large samples that can be applied to the general population, but, in the words of Flyvbjerg, as the process of adding to:

> […] the collective process of knowledge accumulation in a given field or in a society. A purely descriptive, phenomenological case study without any attempt to generalize can certainly be of value in this process and has often helped cut a path towards scientific innovation. This is not to criticize attempts at formal generalization, for such attempts are essential and effective means of scientific development. It is only to emphasize the limitations, which

> follows when formal generalization becomes the only legitimate method of scientific inquiry. (2006, p.424)

Together with Deborah Trumbull, Stake (1995) calls these processes of generalization ‘naturalistic generalizations’ (1995, p.85), arguing that generalization occurs when the readers feel that what is described may happen to themselves, through well-described situations and experiences. This means that the kinds of generalizations that a case study can produce are, according to Hamilton, ‘within the realm of private knowledge’ ((1981) cited in Stake, 1995, p.86). Thus, a good description is important, with relevant aspects and facts (Creswell, 1998). I will argue that this research provides a sufficient amount of descriptions and evidence to allow the reader to establish his or her own interpretation and compare and contrast it with interpretations made by the researcher, making it possible to use the information constructed in this study in different ways.

Kennedy (1979) went even further, defining generalization as a process, referring to a range of processes where naturalistic generalizations can be made on the basis of judgements made by the readers or receivers. They are the only ones who can establish whether the findings of the research fit with their own situations, taking generalizability to the level of shared responsibility:

> That is, the evaluator should produce and share the information, but the receivers of the information must determine whether it applies to their own situation. Because the evaluator cannot know who his receivers are, he must, of course, be quite specific both in his description of the attributes of his case and in his description of the way in which the treatment influences this case. (Kennedy, 1979, p.672)

Thus, this position makes generalizability not only the researcher’s responsibility, but also the readers’. Iqbal, Gatward, & James say that generalizability means ‘to “generalize” findings from one particular research setting to other, (potentially) unknown settings’ (2005, p.34). This statement seems to contradict Stake’s statement, but that is because such generalization is made on the balance point between the way the analysis is made and the way the interpretations are made, and the assertions or propositional generalizations are described and produced by the reader, if the experiences in question have happened to them (Stake, 1995).

7.3.2. Validity

The first step towards talking about validity is to try to define what it is; there is common agreement that ‘validity refers to the truth and correctness of a statement’ (Kvale, 1996, p.236). In this context such truth should be compared to what is valid knowledge, and according to Kvale there are three classical criteria that characterise it: the correspondence (the extent to which the knowledge corresponds to the objective world), the coherence (looking at the consistency and the internal logic) and the pragmatic utility (regarding the relation of such knowledge to its practical consequences) (Kvale, 1996).

On the other hand, according to Cohen et al. (2000) the validity of qualitative data

> […] might be addressed through the honesty, depth, richness and scope of the data achieved, the participants approached, the extent of triangulation and the disinterestedness or objectivity of the researcher. (2000, p.105)

However, while all these characteristics should be present in research that draws on qualitative data, more formal criteria need to be established, observing protocols or procedures that can frame the expectations to the data to define their level of validity. Such protocols can be defined as triangulation (Cohen et al., 2000; Creswell, 1998; Fetterman, 1998; Stake, 1995). This research has based its triangulation on the data source triangulation (Denzin, 1984 cited in Cohen et al., 2000; Denzin, 1984 cited in Stake, 1995), and Cohen et al. (2000) distinguish between time triangulation, space triangulation and combined levels of triangulation. Time triangulation was used explicitly in the Marcus case study, as the interviews and other methods were used at different times and under different conditions concerning the subject and his relation to the researcher. Space triangulation was used in the two case studies conducted in two different educational environments, that of Marcus and that of Julio, which were also situated in different contexts and cultures, in order to determine whether some of the meanings found were experienced differently in singular contexts. Many of the situations experienced by the interviewees were described in very similar ways, regardless of the context, giving the research strong validation.

Methodological triangulation was used in the Danish case through the use of interviews, observations and chat communication. In Costa Rica this protocol was used more consistently. Therefore, such triangulation has its value in the variety of sources, understanding the phenomena and providing multiple evidences to reinforce the validity of the data. What is relevant is to compile a variety of experiences in order to depict as far as possible a more comprehensive understanding of blindness and blind people's interaction with the environment. For instance, in Julio and Vicente's case, observations and interviews were conducted, and they also participated in the production of documents for the future workshop. In the case of the School of Informatics, the workshops produced documents from the teachers' perspectives that were reworked with the students to validate the teachers' views against the students' experiences. This double work gives validation to this material that was used later in the research. Also, most of the activities conducted with students and teachers included observations that were supported with videos and audio recordings. Therefore, I agree with Kanstrup (2005) when she stresses the role of variety in the choice of methods:

> As pointed out by Denzin & Lincoln, qualitative research is characterized by a wide set of methods and these methods are often used in combination. However, not to reach validity or generalization but to get closer to the understanding of the phenomena that we are studying […] "the use of multiple methods, or triangulation, reflects an attempt to secure an in-depth understanding of the phenomenon in question. Objective reality can never be captured. Triangulation is not a tool or a strategy of validation, but an alternative to validation […] The combination of multiple methods, empirical materials, perspectives and observers in a single study is best

> understood, then as a strategy that adds rigor, breadth, and depth to any investigation. (Denzin & Lincoln 1998b, p. 4;(Kanstrup, 2005, p.65-66).

Considering the resources and time consumption that triangulations imply, Stake is emphatic in pointing out that only the important data and claims must be subjected to triangulation. This is related to the understanding we need to give to a case, how much such data and claims can clarify or illustrate or the level of mediation needed to settle potential meaning conflicts (Stake, 1995).

Then, the use of different triangulations in time, space and methodological instrumentation gives this study a solid base for validating the sources of data. The same can be said for the correct interpretation hereof, as the data were analysed using the same triangulation as in the collection of the raw data. Therefore, collecting data from different contexts and different actors was the strategy used here to compile the data required to understand blindness and to define the areas where educational environments may need improving in order to achieve inclusion.

7.3.3. Reliability

For positivistic and experimental research approaches, the reliability of the research is determined by its consistency and replicability. Considering this research, consistency is provided by the triangulation described in the previous section. However, Yin (2003) argues that in order to replicate a case study it must observe the same case and follow the same procedure. This means that it is not possible to replicate one case study in another case study. Indeed, the concept of replicability is completely different from that of a quantitative research context; thus, the only way to go about it is to follow the documented procedure of this research (Yin, 2003).

In this sense, having audio and video recorded much of the interviews and observations provided a solid base for the expected replicability. The systematic work with the recordings, the transcriptions and the documentation of the workshop results in papers and photography also provided a solid base for data reliability.

This does not guarantee that other researchers, following the same recording procedures, will end up with the same conclusions, as is widely discussed by qualitative researchers (Cohen et al., 2000; Creswell, 1998; Fetterman, 1998; Kvale, 1996; Kvale & Brinkmann, 2008; Yin, 2003). The best way to help other researchers arrive at the same results is to highlight the researcher's considerations concerning the context and the conditions on which the conclusions were based.

7.4. Summary

This chapter has dealt with methodological considerations for qualitative research, inspired by ethnography. It has also explained the use of different methods and different perspectives taken from the literature review on the subject of blindness, which at the same time has helped this research generate an understanding of phenomena linked with the perspectives of blind students. I have described my use of interviews with blind students and workshops designed with a twofold purpose, one purpose being to gather information from the educational context. These have provided a better understanding of the phenomena under study, adding 'rigor, breadth, and depth' ((Denzin & Lincoln 1998b, 4) cited by Kanstrup, 2005) to the research.

Therefore, the following chapters will address the construction of data from the case studies and the workshops, before the final chapters will present the analysis and final thoughts on the work and the theoretical frame hereof.

< CHAPTER EIGHT >

CONSTRUCTING THE DATA

Ever, since I was seven years old I've gone to some kind of school, so I'd really like to go and have some work. And then I would rather say afterwards, I would like to study more if needed. Because I would like to earn my own money and have my own house and try to stand up on my own two feet in the sense that I have work, I have something to do every day. (1092B, Danish student)

Throughout the previous chapters the key question has been raised several times: What does it mean to be blind in tertiary education? Indeed, this is a question to which there is no simple answer, just as there are no simple answers to the questions: What does it mean to be a foreigner studying in Denmark? What does it mean to be a woman in computer sciences? What these questions have in common is that their answers are related to identity, practice, social structures and experiences.

In this chapter I will present the data collected in the interviews with the three students, and I will try to construct a picture from their life experiences in order to answer this main question on the basis of the interaction of the discovered facts.

8.1. The experience of being blind in higher education

For most upper-secondary school students enrolling in higher education involves making several decisions. For example: Should I continue studying or proceed directly to the labour market? If they decide to continue their studies, another decision must be made concerning the desired career path. These decisions determine the educational environment in which the students are enrolled and the type of challenges they will have to face. Finally, they determine the part of the labour market where the students are able to use their knowledge and develop their new skills. Here it is important to highlight the impact these decisions have on the identity of blind students and the degree to which this process influences their trajectory.

8.1.1. A student who planned his tertiary education in advance

Before my first meeting with Marcus I contacted him by email to explain the purpose of my research: What are the needs of blind students studying computer sciences at university? His answer to my main question was: 'I am glad that people take an interest in this particular area' [2B][6], acknowledging that there are things here that need to be done.

In the same email I informed him that, according to the Institute for the Blind and Partially Sighted, he was at the time the only blind student enrolled in a computer sciences career programme in Denmark. Marcus' reaction to this information was: "I am both surprised and a little shocked that I am the only one in Denmark currently taking any study related to computer science" [3B]. His surprise and shock are linked to the fact that Marcus had wanted to study a subject related to programming since he was just seven years old (born blind) [17B]. From an early age he had been determined, and he had done everything to accomplish his goal. Early in life he learned English in order to be able to communicate with

[6] References with the [NX] format are references to the Field Work Empirical Report (Vargas, 2009)

the computer through screen readers which in the beginning were only available in English. Then he went to primary and secondary school, before he proceeded to an international business college to study mathematics and economy. Then he spent one year at the Institute for the Blind and Partially Sighted and, finally, enrolled in technical college [17B].

A governmental student counsellor questioned Marcus' chances of completing this educational journey, but that did not change his mind and he continued to pursue his goal:

> I went to the Institute for the Blind and Partially Sighted, where a government student counsellor met me and told me about the … ah … that … nobody is studying computer science any more, which is difficult, you need to be too mathematical and such … I do not think that is true. [17B]

This kind of discourse can occur several times in the life of a blind student, erecting barriers rather than trying to prepare blind students for the challenges they will have to face. Marcus tried to prepare himself, following the steps that he knew would give him a chance to enrol and eventually complete his studies. He was not discouraged:

> […] so I was glad to get back in this world [talking about the programming school] and start the education in equal terms with the sighted people and to my horror I discovered that I was very far ahead of most of them in my class, it was actually quite sad, because I've been programming for a quite long time, it is definitely my best subject. [17B]

From this perspective it is not clear what supported the presumptions of the above-mentioned counsellor. I will go into more detail with this later, when I analyse how blind students like Marcus can prepare for the educational environment in the next chapter. He was emphatic later in the interview:

> One of the things that I keep wondering about is why there are no other blind guys but me that have taken this education. It's not very hard actually. [625B]

Interestingly, I did not have to wait long for Marcus to get into the technical jargon, and even though we were talking about some tools he had to use, he jumped into a discussion to justify why Jaws[7] did not suit his needs; instead he used Window-Eyes,[8] because the product was cheaper, it offered better services, [59B] and he needed a product that could be installed on different computers at the same time. This is important, because he has four different computers for different uses. This was the moment his technical identity became evident.

After this explanation he soon started to talk about Orca,[9] a screen reader for Linux [63B], but he was more interested in talking about other things and asked me whether I used Linux[10] and what languages I used for programming. Also, he was critical of Vista[11] as a development platform and said that he would not recommend it, but as a software developer he was also curious as to how easy or difficult Vista was to use, compared to Linux [289B].

Marcus continued to take advantage of the fact that he was being interviewed by a computer scientist and asked me if I could give him a practical example of the Barber Shop Problem[12] [396B]. This is a question that is not frequently asked in a conversation, at least among non-technical persons. And the way Marcus posed his question revealed to me his well-defined identity as a smart guy: 'Now that I have one equal intellectual like myself …' [404B]. After I had given him a satisfactory answer, he complained about one of his teachers who had been unable to come up with a practical example when Marcus had asked him the same question [474B].

Hence, it is not surprising that his computer skills are more than well-developed. I base this on the fact that Marcus has four different computers with different operating systems (he has experience with Windows Vista,

[7] JAWS is a screen reader from Freedom Scientific, Inc.
[8] Window-Eyes is a screen reader from GW Micro, Inc.
[9] Orca is an open-source screen reader developed by GNOME Project.
[10] Linux is the family of operating systems Unix-like, based on the Linux Kernel
[11] Vista is an operating system with a trademark from Microsoft Corporation.
[12] The Barber Shop case is a typical example used to coordinate computer processes; it is taught in operating systems courses.

Windows 7, Ubuntu, FreeBSD[13], MacOS[14]) [63B, 606B] and on his narrative of how he was able to prepare the installation disk to allow himself to install the environment FreeBSD. The complexity of this task lies in providing an oral interface to the installer of the operating system without having an operating system that supports the screen reader [890B].

When we talked about assembly, probably the most difficult programming language, Marcus mentioned:

> I always envied the people who set up these big machines, have to fix all together and just to set a lot of assembly code, and need to know what in the hells go wrong here. [78B]

In fact, even assembly is difficult to read using screen readers, because it uses mnemonics and numeric addresses and probably force blind people to use Braille keypads to read it properly. Marcus clarified that it was difficult to use, but not for blind users in particular:

> […] it is extremely difficult to understand, I think … actually it shouldn't be, it is as it is … as far as I see it. The problem with the assembly is there are so many dialects, for so many different processors, so it is not very portable. [81B]

However, when we got to his experience with assembly courses, he tended to complain about the teachers instead of revealing any difficulties he may have had with the subject in question. I wanted to clarify that in my own experience as a computer teacher most students tend to find this subject difficult:

> Definitely, it is also extremely interesting to study it, but the teacher I had was … I don't like to say incompetent, but he was not very good at teaching assembly. [86B]

[13] FreeBSD is an operating system with a registered trademark from The FreeBSD Foundation.
[14] Mac OS is an operating system from Apple Inc.

Throughout the interview these points of tension occurred between Marcus' identity as a technical student and his negotiation of being blind. He had prepared himself to the extent that he now found many of his classes boring or his teachers incompetent or not knowledgeable enough for teaching the courses in question. He compared the competences of his peers to his own to make it clear that he was at the top of his class. Still, he needed to validate his preparation as a programmer, questioning his technical identity:

> Yeah, but do you think my basis are well covered as programmer has learned both C+, C# and C. I studied a little bit of Pascal but it was long ago [...] Do you think my bases are well covered? [534B]

He complained about his teachers three times: '… the teacher didn't know very much about the subject from outside the book that I read, so it was a pity…' [105B]. Furthermore:

> […] the teacher didn't know very much about the subject, he has hardly set up some router, he is still using to sketch modems. That is the problem because when I wanted to hear something about security, I wanted a teacher with competences, who knows about the subject, he was in his first time experience with security products. I don't want a teacher that can read a book, write some notes and say you can use the book or something like this. [186B]

> […] it is a very interesting subject and it was made extremely boring because the man doesn't know much about it, I know more about it that he does, that is scare I think … because I don't like to say that I know it better than the teacher. [188B]

His complaints were extended to his peers. He clearly disapproved of the students who did not pay attention or showed disinterest in class, and he respected those who had difficulties in class, but nevertheless did their best. This was also accompanied with his perception of himself in the top three of the class, characterising himself and two of his peers as 'fairly bright' [194B]. This corresponded to his 'smart guy' identity.

On the other hand, he did recognise situations that complicated his studies. I will highlight two different observations in that connection. Firstly, Marcus' difficulties were not related to specific subjects, but concerned more general requirements, such as easy access to written material:

> I know that there are things that are definitely more difficult as soon as we start talking about scanning the papers, copies and all this things, it would be of great help if teachers already new that for … it would be much easier for all people involved, both sighted and blind, to say, "there is a place out here and in our Internet, it is placed in this folder". [26B]

Secondly, even though his request to his teachers to make the material available in an online folder was to enable him to read the material with a screen reader, with no extra work, it was important for him to note that this solution is not only useful to him, but to all students, sighted or blind.

Also, he confirmed that he did not need additional tools for following the given career programme, and his difficulties with the course largely depended on his teachers. In fact, this dependency was especially evident when graphical elements were involved:

> The only subject that is a bit hard, at least for me, is artificial intelligence. That is probably because our teacher is ... not very … How can one put it? He's very concerned about the graphic things, and he's not saying, "We have to make this, because such and such." And that's why it somehow ruined it. But the other subjects, like databases, distributive systems … and a lot of the others … they are actually very, very nice to be going along. [627B]

However, he had to admit that some tools with graphical interfaces are helpful and necessary for producing high-quality software, establishing a conflict between Marcus as a 'technical guy' and Marcus as a 'blind guy':

> […] software engineering was set with all the UML diagrams, a lot of things like that, extremely boring, but quite helpful to make good, well done programme. [109B]

Marcus' identity as a 'smart guy' constituted a strong tool for negotiating his blindness, empowering him, especially in school contexts where he could, for instance, compare himself to his peers. He mentioned that he scored higher marks than his workgroup peers, acknowledging explicitly their ability to see in contrast with his disability [124B]. The clearest demonstration of how he sees his school performance and his position in the educational environment was probably his answer to the following question: Why do you think that you need to be more prepared than …?

> Because I think my requirements are bigger, I think it takes... I know it takes more resources to sit at the school for the whole day, listening to the teachers, taking notes and making a summary of your notes, its take more resources from you than its does from the others, because they are able to start looking around, it is difficult to explain … they have the eyes to see with and I most get the same information that they get in other ways and process it in other ways, so, that is why I am not actually sad of have prepared too much, I am sad the other are not in my level. [200B]

In that connection Marcus also reflected on why he was able prepare better than his peers. Three of his friends had joined our conversation a few minutes earlier, and one of his friends assured us that Marcus had very good conditions, paradoxically, because of his blindness. Marcus' answer to this remark was:

> As I am trying to say, don't think that me in … perhaps a little more clever than my classmates, don't think that is anything related with being blind. I think it is something due to the limited of possibilities that I have for expressing an interest in something that the others can just go and play basketball. So I spent more time at the computer. I have done so all my life. So I have spent more time learning how it works, and that is the whole thing. I think it is more the interest and also the things that you are able to do. [549B]

Here the negotiation between the 'blind guy' and the 'smart guy' was reconciled with a third identity, the 'technical guy'. His expertise, his passion for computers, his technical jargon and his high level of preparation converged here. It was clear to me that Marcus had excellent conditions for studying programming, and that he had moulded his blindness to overcome any obstacle that might come between him and his goal. Nevertheless, the lack of accessibility in computer programmes [384B] or conflicts with stigmas and misunderstandings irritated Marcus. Even though these situations were barely brought up during our conversation, indicating that he is neither heavily influenced by negative conceptions of the perception of others nor does he expect his surroundings to adjust to his needs, but when he did get into these themes, he played it tough.

An example of this was related to the use of audio books that were read aloud in a slow pace, because the books were intended for people with dyslexia. Marcus said, ‘Who ever got the general genius idea to put blind and dyslexic in the same category, should be shot’ [358B]. He explained that even though he is not a fast reader, these audio books take him twice as long to read, giving him the impression that people consider blind people more limited than they really are [358B, 730B].

Another example of his ‘toughness’ is related to limited accessibility which again limits his self-sufficiency:

> I’ve heard so many “Why do you insist that we do not help you?” Because the worst thing that can ever happen to me is that I have to call some of you guys and say; “hey, my Windows is actually broken down. Can you help me?” [899B]

Marcus’ self-sufficiency was even clearer when he described his future, but this time he was not as confident as before. He did not consider his prospects as promising once he finished his studies. He was worried that he would be unable to get a job [1092B, 1364B].

After I had completed my field work I stayed in touch with Marcus and not long after he had graduated did he get a part-time job and, eventually, a fulltime job. So, he continues to pursue his plans.

8.1.2. Making decisions and a change in life

Julio is a young student at the Universidad Nacional in Costa Rica, and he lost his sight at the age of 19. He lost sight on one eye when he was two years old in an accident, and probably due to the extra strain of using only one eye, he lost around 20 per cent of his remaining sight. Then at the age of 19 he was diagnosed with congenital glaucoma, and three months later he was blind [61Y]. Firstly, he needed to negotiate his new condition, the environment and his prospects. He started to see himself as a blind person, and he felt embarrassed, because he had difficulties doing some things, afraid that people would make fun of him [58Y]. He was demoralised. His counter reaction to this was to study theology to become a priest:

> […] because when you lost the sight, you get demoralised and the first thing you send to the hell is God. Then in order to have interior peace, the first thing is to come back to God, and I wanted to fell easy, getting more into God's, to believe in a Superior being, I wanted to become a priest, well I wanted to turn to the spiritual side. But then, I felt that this was not for me, in part it was because I was losing my sight, but definitely, this was not for me. [90Y]

After this experience he finally decided to apply to a university and change his career path and become a counselling teacher. He felt more confident in the university environment once he learned that he was not the only blind student. After sharing his experiences with other blind students attending different career programmes at the same university he understood that it was possible for him to continue studying [90Y]. It is interesting to compare Julio's behaviour with the standard behaviour of sighted students enrolling in university for the first time. The latter do not need to validate whether it is possible or not to study at university; they only have to go as far as to establish whether they have the personal skills to finish their career programmes.

Julio had to face another difficulty: he came from a low-income family. He wanted to change his career programme to psychology, but he felt that it would be better for him to finish his current programme, as a backup, in case he got stuck in the other career programme. In this way he would be able to support his family [95Y].

Talking about the reasons why he did choose to study counselling, Julio explained:

> I think I chose this career, first because it is more theoretical […] the classes are more theoretical oriented, but exceptionally the class has some activities, and you need only to observe and then transcript it. So, I think it is lighter, more accessible and…. you do not have too much mathematics. In fact, people study counselling because is running away from mathematics. [180Y]

His phobia to mathematics was emphasised when he lost his sight [192Y]; thus, it was important for him that the programme he chose did not involve mathematics.

It is interesting to highlight Julio' tendency to make explicit his blindness and the difficulties he has to face.

> There are people that deliver their research works including images of something that illustrates the theme that they are presenting. We as blind never include an image, our work is in black and white and nothing else, we do not include any colour, we ignore this option. Sometimes I wish that Jaws could describe, at least a little bit the images, and I may include one, at least in the cover, but the true is we deliver the work in black and white because we cannot read images. [228Y]

In this and other interventions Julio used 'we' as a way to identify himself as a blind person in a separate group: 'we, the blinds'. In contrast, Marcus expressed a clear desire not to be classified in a 'blind group'.

8.1.3. The trajectories of the students

These stories establish a significant distance between the perspectives of Julio and Marcus, respectively, but many other circumstances also indicate that such a difference exists: Marcus was born blind and Julio recently lost his sight; they come from different cultures; Marcus is more task-oriented and Julio is more sociable.

Thus, I would like to stress specific points of divergence. Marcus does not have good experiences with the Institute for the Blind and Partially Sighted and was relieved to return to his school and his sighted peers. Moreover, he expressed disapproval of groupings of blind students and wishes to avoid comments like, 'Look at the group of blind people.' For Julio, however, going to the Hellen Keller Institute was a very positive experience. He started to attend the institute before he lost his sight completely; he did this to prepare for blindness. He enjoyed getting to know other young people and that made learning easier for him:

> I asked them how they do to eat, to get oriented, moving by buses, and many other things, so I started to feel in my element, to feel empathy with other persons, so it started to enliven me […] and I saw people using the computer very easy, typing in the keyboard very fast, and I said to myself, "if these people can and they are young and they are blind, the truth is that I also can." […] So I took a typewritten course and then I was able to type faster. [84Y]

A theme that both of them brought up was the relative high importance of having a girlfriend. In both cases they felt more confident through the acceptance their girlfriends showed them, because they understood that they were accepted as they were, with their blindness. This made Julio feel certain that he could be seen as a whole person, not just as a disabled person [281Y]. For Julio, the first day of his relationship with his girlfriend had been the happiest day of his life, and it helped him avoid thinking that everybody expected him to find a blind girlfriend [288Y].

Another point of convergence is mathematics. This was an issue for both of them, even though they approached it from different angles. Marcus was trying to improve his mathematical skills, and Julio was trying to avoid the subject altogether. Although both Marcus and Julio had difficulties with mathematics, I do not consider this an issue that is unique for blind students in general.

What is important about these stories is that blindness is something that is clearly present and influences their lives, constantly. It is significant not on account of the limitations it entails, but the effect that blindness provokes in the people around Marcus and Julio. The better the conditions of the context, the better the acceptance of blindness, because the context helps them cope with their disabilities and sometimes makes them disappear. In this sense, the trajectory of the student is indeed key to the success of the student in higher education, constructing a solid blind person identity, capable of negotiating with the other identities in the process of becoming professionals.

8.1.4. The role of tools

In chapter 4 I described a representative collection of tools that are meant to help blind persons adapt to the context. Not all of these tools are accessible to standard users, and some of them only make sense to those who have undergone special training. On the other hand, new tools should be in the process of being designed, suitable for other purposes, meeting new specific needs of blind people, even if they have not been designed with that specific use in mind. In this case, overall, the appropriation of tools could be easier. The objective of this section is to make a tour through the tools used by the students in these case studies.

8.1.4.1. Mobility and orientation

Mobility tools are not a much discussed topic among the students, indicating universal appropriation of the walking cane. The only topic that was brought up in my discussion with the Costa Rican student was the guide dog, demystifying views on them. According to Julio guide dogs can learn a route, but in a new place they will get lost as quickly as their masters [1Y]. Also, he clarified that the guide dog has some limitations: it cannot protect blind people against obstacles above them like traffic signs or tree branches [13Y]. He also mentioned the difficulties he has had getting onto a bus or into a taxi with the dog or taking it to some public places like university classrooms, because the drivers or the guards or teachers would not allow him to bring the dog. In these cases he is forced to explain the dog's role as a guide, not as a pet, and sometimes his explanations are not enough. Then he has to report it to the guide dog owners association. Subsequently, the association contacts the transgressors to warn them about their obligation to transport or let the dog get into the place in question.

For Julio the guide dog has being a great support, but Marcus, on the other hand, based on his view of guide dog users in Denmark, that blind people who use guide dogs are 'usually the same ones that have no education and just walking around all day, doing nothing' [1160B]. Instead, Marcus moves around his neighbourhood with his cane, and he usually does not move far away from his house, which allows him to be more in control of his context.

In addition to mobility tools, references to orientation tools were very scarce. Julio was the only one who mentioned orientation tools: the support given to him by the Hellen Keller Institute and the support arranged by the Universidad Nacional, where assistant students gave him a tour around campus to familiarise him with the location of different places of relevance. In general, starting a new route requires some form of guide the first time one walks it, and depending on the difficulty of the journey it might be necessary with a second guided tour.

8.1.4.2. Written communication

As explained in chapter 4, written information is made accessible via different tools. Julio commented on this:

> I learned about screen readers and I saw an improvement in my opportunities. Then I learned Braille and I saw that it was possible … then I was able to take notes of the important things and I started to see that I had better access to studies and to information. [75Y]

He almost quit his studies, because he found it impossible to manage seven or eight cassette recordings, which he used as substitutes for note taking in class. It was stressful for him to try to find something on one of the cassettes and impossible to link a reference to written material with the recording [67Y].

In fact, screen readers and Braille were considered fundamental to improve the blind students' opportunities for studying. Marcus did not only evaluate different screen readers to find the one that suited him best; he also experimented with other products to have the screen reader functions, from the initial set-up of his machines and like preparing a set-up disk to reinstall the FreeBSD, with audio support.

This means that screen readers was a topic of discussion in my interview with Marcus. He explained that you need to train your ear to set the screen reader at a higher speed and thus become better at locating information on the screen, finding a file in a directory, etc. Also, when you speed up the voice, the reading is made more private in a sense, as sighted people rarely understand the information at that speed [278B].

Another interesting fact that Marcus noted about screen readers is that he learned to read Danish using the English synthesizer. This meant that he used the English reader to read Danish, implying that the software read the Danish words with the rules, phonemes and accents of English. Such an exercise requires that the listener can hear the Danish words through the English phonemes, and he will need to translate these phonemes to the corresponding Danish and then understand the content [998B]. (This ability was also observed in Hans Rasmussen, a blind employee at the Institute for the Blind and Partially Sighted, who offers support to students using computer solutions).

As Julio is not studying a technical discipline like Marcus, Julio was more dependent on reviews of tools and on people who could help him install the tools. Indeed, even though Julio complained about the accessibility to some tools, such as PowerPoint or PDF formats, Marcus had overcome this, using more recent versions of the screen readers JAWS[15] and Window-Eyes.[16] This did not solve all accessibility problems, though;

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[15] JAWS is a trademark of Freedom Scientific Inc.
[16] Window-Eyes is a trademark of GW Micros Inc.

some PDF formats were still problematic, like when the creator uses a specific check box, not intended for that particular use, and ends up with an undesirable result [1223B, 1239B].

Both Marcus and Julio preferred listening to screen reader than to the recorded voices of real persons. Julio said:

> I prefer to listen JAWS, because the people sometimes pronounce wrongly a word and it is difficult to understand, or sometimes they are recording sleepy, instead, the JAWS is “without laziness” and it is more constant and it gives you more clearness of the text and you can repeat the word letter by letter, just if you need to know how to write a name and I think I can understand better. [144Y]

In addition, Marcus was even more emphatic about audio CDs:

> But that is not the worst of it, the worst of this audio CDs was “the person reading was reading incredible slowly” (spoken very slow), because it was made for dyslexic people and who ever got the general genius idea to put blind and dyslexic in the same category, should be shot, I am not quite fast reader, even compared to blind guy, I read 114 words per minute, if you said, you should read 100 to be able to study. [357B]

His concern was to keep the rhythm needed for his courses, so he had to increase the reading speed to be able to cover all the material [728B, 731B]. Listening at that speed resulted in concentration difficulties. He also clarified that sometimes he had to slow down and listen more carefully to important passages [759B].

They agreed that Braille constituted an important source of extra support. Moreover, for Marcus reading Braille was more than an alternative way of reading; it was a way to enjoy reading: “because then you can get it through your fingers” [353B]. For him this justified buying a Braille Sense [1030B].

According to Julio:

> Learning Braille is like to play piano, if you practice it all days, you can improve your proficiency and you can read very fast, but if not, you will not have the ability, even if you can recognize the letters [147Y].

That is, as Braille is an important tool, one has to practice using it. And this is where the availability of tools plays a fundamental role. In Marcus' case some of his tools had been provided by the social system and he still had the resources (which he had not necessarily received from the state; this was not established in the interview) to buy extra tools. Julio's resources were more limited, though, both the resources provided by the state in the form of hardware support and his personal resources, as he came from a low-income family.

8.1.4.3. The tools the students use in academia

The basic tool the students interviewed use in academia is the computer and the screen reader, and the discussions focused on which software was accessible or the degree to which the software supported them. For example, Julio complained about the anti-virus software, because 'the more accessible anti-viruses are not as effective detecting virus than others that are not very accessible' [178Y].

Marcus, as a technical guy, had experience with different software; in fact, he used different tools for the same purpose. He was using Ubuntu,[17] Windows[18] and FreeBSD as operating systems on different computers. While Ubuntu was very easy to access [883B], FreeBSD allowed him to work from scratch, without assistance from a sighted person [897B]. However, Windows had one very desirable advantage:

> […] the standard controls are very well, they are very well supported by all the assistive technology, and that is the one big advantage that Windows has over Linux, that there is one user interface, they still have hundreds that programs on it and that is why so many people use Windows, I think … one of the main reasons … at least, that is why I use

[17] Ubuntu is a registered trademark of Canonical Ltda.
[18] Windows is a registered trademark of Microsoft Corporation.

> Windows, because I have only one user interface to work with and I don't need anything else … if that is not possible it's terrible … you can use the approaches I say before by creating a complete separated user interface, that are just accessible to blind people. [182B]

The tools Marcus used for programming were also Microsoft tools; for example, he used WordPad to write Visual C++ or Visual C# code, as these languages do not offer accessible solutions [925B, 954B]. Furthermore, he started using the compiler for Visual C++ 6.0, and then, when Microsoft released the new version, he kept using it. He chose to use this compiler, because it had advantages for him as a blind person, but also as a student: because it is a command line compiler, it provides more information of what is happening behind the compilations[19] than the graphical version used by Marcus' classmates [956B].

In contrast, the situation was more complex with regard to UML,[20] which is a standardised modelling language for developing object-oriented software. One of the characteristics of this modelling language is its graphical interface: visual symbols are used to depict the different components of a system. Under this premise, the limitations for non-sighted people are obvious, at least on the face of it. Chapter 4 mentioned a European initiative called TeDUB: a project that focused on developing a tool that would allow blind students to navigate through its graphical representation to get a description of the information registered in the structures (Horstmann et al., 2004; King et al., 2004). The project was not a success, as blind users eventually concluded that the tool was effective for examining UML diagrams, but it was not sufficient for creating the diagrams (Balik, 2011). Therefore, Marcus needed a tool to be able to pass the course, and he agreed with his teacher that he could write the text and then the teacher would draw the diagram following Marcus' directions. He succeeded and got the highest mark [111B].

[19] Compilation is the action of reviewing the syntax and semantics of high-level programming code to low-level code to be executed by the computer.
[20] UML stands for Unified Modeling Language, and it is a trademark of Object Management Group, Inc.

Other complementary tools used by Marcus include GoldWave[21] and CDex,[22] which are used to normalise the audio and then it is possible to increase the volume if necessary [737B]. The tools proved useful when he recorded a class, especially when it was noisy.

Interestingly, the most complex tool Marcus used was his peers. This is so, because interaction with this tool required evolution, understanding and empathy. It was used in interaction with his friends and during class, directly or through a chat tool, in order to obtain the details that had been presented in the classroom and noted on the blackboard, but not made available in digital format and with no detailed explanation [645B]. In addition, if the information he had been able to obtain from the class was incomplete, he relied on friend support to discuss the topic in question again [648B].

This dependency can disturb the student, as Marcus has explained. In some group projects, for example, where the other students assumed the user interface, he had to wait until they had almost finish. Then he needed to do the programming and reserve more time after he finished his part to explain the code to his peers; something that is not always possible [153B].

8.1.4.4. Dreaming with new tools.

In this context the students were persistent in pointing to desired tools or redesigns of existing tools. Marcus noted the importance of using existing accessibility tools in the development of software, maintaining the existing keyboard navigation (tab, shift tab and other keys that people expect to have) or naming the keys and graphical pictures, which means that the blind person knows what the key or picture indicates as soon as he or she points at it; this could be reproduced by the screen reader. If this is not possible due to specific customer requirements, Marcus recommends a separate interface with accessibility as a minimum [178B].

[21] GoldWave is a copyright 2011of GoldWave Inc.
[22] CDex is a copyright 2007 of Free Software Foundation, Inc.

Marcus noted that blind people's difficulties are not merely connected to the screen. For example, it is not possible to rewind a recording on a DAISY CD; this can only be done for entire sentences at a time, and only if they have been marked [765B]. In fact, he was working on a tool that could convert DAISY format to a more compressed digital format, allowing the user to place marks anywhere in the text. Now, he is interested in transferring this tool to a mobile device [1695B].

Other dreams are related to improving ways of reading mathematical formulas [347B]; tools like MathM, LaTeX, AudioMath and others were mentioned and discussed in chapter 4, but Marcus does not seem to use any of these. These tools do not constitute adaptive technology, as they cannot convert standard information in any document into their own format. This has an important implication: these tools must be used in the design phase of a course, meaning that they require special preparation on the part of the teachers. These tools cannot convert information from any commonly used source.

Indeed, this was the situation in some of Julio's dreams or wishes. When attending a lecture where a set of special working techniques were explained by a guest lecturer, and all the techniques were visually oriented, his conclusion was that all those techniques would not help him in any way in his actual or future life [219Y]. At the same time, he would feel excluded from the lecture and started to dream about when the material in question would be made available in digital format [225Y]. Also, he suggested that people should incorporate into their techniques things like 'forums from music or narratives, dramas, group discussion' [240Y]. He also recognised his limitations in connection with taking tests; he depended on the support of the counselling department, changing the way he could go about the test or providing additional technological support [240Y]. But this would raise another problem. They would need to have 30 computers, one computer per student, but the school resources were usually too limited to further support Julio [241Y]. These limitations do not seem present in Marcus' context, where everyone in class has a personal computer [784B].

One of Marcus' dreams concerned the participation of his teachers, using the tools he imagines:

> […] it would be very great if the computers came to play bigger role from the teachers perspectives point of view, if a system could be developed, that set: you have a blind person sitting there, in a back sit; and we have a sort of ... whenever the teacher type something in his computer, or does anything in his computer, it is transferred to your machine, so your screen reader can see what he is doing, for example if he is using notepad, writing something about source code, it will be transferred to your machine, so that, you won't have to take notes; you just have a copy of what he wrote in the blackboard, then you can focus more in what he is saying, and make the work, a little better. That would be one way to solve it, because it will free a lot of resources from you, because you shouldn't need to take notes and you don't have to ask others to take notes for you, you won't have to do it at all. [209B]

Two other dreams concerned a tool that could help Marcus develop GUI, because even though he was able to add a GUI to his application, he 'wouldn't be able to see how the things were placed on the screen' [1912B]. The other dream was:

> I was thinking something along the lines of a hardware screen that you connect to your computer. On that screen you can then feel, with your hands, what's present on the screen. Include a button like the one on my watch so that the screen becomes sensitive to touch. Then, you position your finger on the thing you want to move and then put it in the new position. It would probably be as big as an ordinary screen (17 or 19 inches), but it would still be extremely valuable, at least to blind persons ... What I am thinking about is a display that'll automatically refresh itself so that we can save it on paper. [1920B]

As described in chapter 7 in connection with my field work I conducted a future workshop to explore the dreams of a group of blind students from UNA; one of them was Julio. On the basis of the first part of this workshop the following list of current situations and students' expectations was obtained.

Perception of a group of blind students concerning difficulties connected to studying in the UNA environment
Teachers should:
Talk directly to the students about the adaptations required for class.
Modify the course plan to make it accessible to visually impaired people and others in general.
Allow assignments, homework, tests and other material to be submitted electronically, via email, promoting accessibility via computer and JAWS systems.
Sent material and readings in digital format, preferably in a Word format.
Offer individual support to reinforce classes and to answer any questions or doubts the students might have.
Ask sighted students to support students with disabilities, under the UNA collaboration hours programme.
Allow the students to carry with them any adaptations they might need in class.
Prepare exercises or group dynamics so that they were accessible to visually impaired students, without excluding the rest of peers.
Evaluate the learning processes of students with disabilities in order to modify contents, based on their learning, and improve their performance.
Understand that some activities are uncomfortable for these students.
Provide all information or slides before class.
Other people should:
See students' disabilities as any other characteristic of that person and not as a limitation.
Should offer to help students who are lost.
The infrastructure:
Poor physical infrastructure is a reason why some choose to navigate using a guide dog. Otherwise it is difficult to move around.
It is important to scan the material with a minimum of quality. The software in the 'project' is not accessible.
Laptop for taking notes in the class.
The recorder is a good tool for taking short notes.
Using recorders in discussion classes or expositions, when the lecturer is not using PowerPoint.
Digital recorder.
A memory stick for exchanging information.

Table 8.1. Perceptions collected during the future workshop conducted by the author at UNA.

In the third phase of this workshop the students were asked to dream, with no limitations regarding the cost or the capacity of existing tools. Even though the scope was limited to academic contexts, the students tended to extent their dreams to general contexts:

Dreams from a group of blind students at UNA
Supporting their studies:
Depending on cultural change:
Sustainable accessibility. To not depend on others.
Possible with economic resources at UNA:
Laptop with JAWS. Audible identification of classroom doors. More access to virtual libraries. Mobile blackboards, taking advantage of the light. The furniture should be accessible to any student: adjustable height, strong, big enough for holding laptops and other equipment. A graphic embosser. A lab with all accessible equipment. A person moving detector, especially in classrooms.
Needs research or not reachable from UNA:
A portable scanner that can read aloud what is written in a document. An image reader, capable of describing imaged. Example: a woman’s face, with blue eyes. Making the JAWS voice more human-like. Computers 100 per cent accessible for text and graphics. A slide reader. A blackboard that talks as soon as the teacher writes on it. Any solution in the classroom should have a loudspeaker. For group work, computers should be able to share information in real time.

(Continued)

Supporting their everyday lives:
Depending on student resources:
Everyday artefacts that are not accessible: e.g. TV menus. Artefacts should talk. E.g. the kitchen should say if a cooking plate is hot or not, or it should announce the temperature. A microwave oven should say how much time is left. The house telephone, the lost call number. The coffee maker should say how much time is left or how much water or coffee it contains.
Support for doing sports. A bowling ball that provides information about the pins; a ball with sound.
Table games. Chess with squares in two levels to distinguish between blacks and whites; the pieces could be pinned to the board. A Monopoly game with identification of each slot. Bingo in Braille format.
A scanner that is able to read aloud small labels.
A speaking stick.
Not available yet for the public in Costa Rica:
A car that can be driven by a blind person.
Street sign reader, including bus signs.
A camera that can take pictures and describe them.
A way to locate persons at meeting places, like a GPS.
An environment descriptor that can e.g. say where the trash can is situated.
An object finder. Every object can produce sounds, making it easy to locate them.
Accessible refrigerators and freezers, making it possible to distinguish the drinks stored in them.
Braille menus in restaurants.
A mapping system in supermarkets for locating products.
An accessible video beam that reads aloud, regardless of the source.
Accessible doors that can be opened from both sides, easily.
A dirt detector that can tell the user when cloth or other items are dirty or stained.
Identifiable bank notes.
A movie home editor, providing audio descriptions.

Table 8.2. Dreams from the future workshop conducted by the author at UNA.

8.2. What does the education environment do?

I have a good impression of the students' identity formation, but although they mentioned some of the situations from the context that affect them I will keep their own descriptions of these situations. Now I will leave the individual aspects and describe the discontinuities in the context from their perception.

8.2.1. Institutional support

The first thing that alerted me was, as mentioned above, Marcus comment, 'I am glad that people take an interest in this particular area,' [2B] as a kind of wish for more attention to his needs. Certainly, this was not meant as a complaint, but it indicated to me the amount of work that still remains to be done.

In Marcus' context two different instances were mentioned: the Institute for the Blind and Partially Sighted and a student counsellor, both of them financed by the state. From the interview it was possible to identify the two roles that Marcus assigns to the institute: a provider of specialised resources and a counsellor and trainer. In both cases, Marcus felt that the services provided by the institute should be improved to meet individual needs.

> I went to the Institute for the Blind and Partially Sighted, where a government student counsellor met me and told me about the… ah … that … no body is studying computer science any more, which is difficult, you need to be too mathematical and such… I do not think that is true […] so I was glad to get back on this world [talking about the programming school] and start the education in equal terms with the sighted people and to my horror I discovered that I was very far ahead of most of them in my class, it was actually quite sad, because I've been programming for a quite long time, it is definitely my best subject. [17B]

Another example concerns Marcus' technical needs. When he was asked whether he could choose tools from the institute, the answer was:

> No, you can't, because if you have to get anything that you … That's actually the situation, it's a little bad and it's a pretty long story. If you are not satisfied with JAWS, then you have to find the money yourself to go to the United States and pay for … for example Window-Eye, in order to get something that is both more stable and far superior to JAWS. [967B]

In both cases the descriptions suggest that Marcus' needs were too specific and did not correspond to the needs of the majority.

He mentioned his student counsellor when he talked about his concern about finding a job. His counsellor helped him in this process [1365B].

Julio also mentions two instances in the interview: the Hellen Keller Institute and the ODA, a programme for inclusion at UNA called UNA Educación de Calidad para Todos. Julio attended the institute when he was losing his sight to learn basic everyday skills: how to eat, how to get one's bearings, how to use busses; but also to learn Braille, to learn how to use computer, to increase his typing speed [84Y] and to learn how to use screen readers [67Y]. When he was enrolled in Universidad Estatal a Distancia[23] (UNED), he kept on using the institute infrastructure, reading books on their computers [76Y, 127Y].

It was when he was enrolled in UNA that he no longer needed to go to the institute [42Y], because UNA provided him with Braille printers, computers with screen readers; for example, in the library they have five rooms with special equipment exclusively for visually impaired students. Still, he evaluated the support he received to cover 60 to 70 per cent of his needs [127Y]. The ODA offered additional support, digitalising books in two levels: teaching blind people how to do it and lending them the required equipment. In some cases the ODA also offers a student assistant service called 'collaboration hours' [131Y].

At the ODA a woman gives students living in student residences cooking advice. Also, voluntary students affiliated to the ODA organises a campus

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[23] Universidad Estatal a Distancia (UNED) is a public university based on different study plans.

tour for blind students, showing them the main and more common facilities at UNA [50Y].

Unfortunately, some questions still need to be solved, and according to Julio one of these is the enrolment system and its limited accessibility [175Y]. Marcus also complained about system accessibility, arguing that very few people know how to design a good and accessible user interface [168B].

However, the students do not merely experience accessibility problems in connection with software interfaces. Marcus said:

> […] like most people don't know that perhaps the user may, probably could be blind or visually impaired and have other things that need to think about it, and it is not taught, I have not heard a single thing about accessibility from the teachers, from anyone in the school yet and I am in the third semester. [174B]

And Julio said:

> I got enrolled in UNED (Distance University), now being clear that I would be able to have access to information, but still I chose a distance program because I did not want to get out of my house, I did not want to get any compromise with other students, because during the high school, there were these kind of behaviours saying, "look, he is blind, he is dummy", many of these kind of things undermined my self-esteem. I felt that I could not get out of the house because there were a lot of prejudgments. [76Y]

Although the students accepted that things were done to ease their studies, they could not simply set these kinds of feelings aside. This kind of cultural behaviour and prejudices diminishes their abilities, but it also assign powers that blind persons do not have. An example of this behaviour occurred when some of Marcus' friends (including his girlfriend) showed up in the middle of one of our conversations and joined us. One of his friends was convinced that individuals' capacities compensate for their blindness. He argued that one of the reasons why

Marcus was especially skilled with regard to technology was that he was blind. After a short debate Marcus clarified:

> […] if you have your sight, if you are able to see, you will be probably playing basketball or being around playing with someone, play football, basketball, whatever, but you are blind so you learn other things … [557] but you don't use your brain that much, you don't have to use your brain that much to play soccer or basketball, but instead if you use the computer, you have to use your brain really much, really much. [562]

8.2.2. How do teachers deal with accessibility matters?

In the interviews the students mentioned their teachers' different approaches to their accessibility; some of them were satisfactory, others were almost non-existent.

The most obvious example of this absence of inclusion practices was a conference I attended which was part of Julio and Vicente's class. The conference was about techniques for obtaining information from children. The teacher started her PowerPoint presentation with some theoretical uses of inclusion; one of her first slides commented on the importance of using inclusion concepts, but the rest of the presentation showed written material and drawings, and she did not mention alternative ways for blind students neither blind children to deal with the material. Later in the interview both students noted that they felt completely excluded from the class in question [218Y]. Vicente said:

> […] in fact, all the situations were extremely visual and sometimes… the worst was … what you felt worst was the implication that if you use this material then, you are good advisers but if you do not work with them, you are bad advisers. Suddenly I felt … I do not know if she tried to say that, but I felt that to work as adviser we need all these papers […] to create an instrument … it goes better an interview, it goes a dialogue, is better an activity, maybe some of these reflections she used, but in other way, maybe more accessible. She did not address the theme for example

> [the accessibility], but in fact she did not talk about education for the diversity, how to use an instrument like those with a blind student, or by a blind advisor, […] and all of these instruments were too visual, only images and she did not get into that … it is now that I am realising it … it is a pity, because I should asked her why? [226Y]

Marcus experienced similar situations with teachers who were prone to using many pictures without explaining the content and who dwelled for too long on theory rather than practical issues [628B, 630B].

As the first level of accessibility, all the students agreed on the importance of receiving class material in advance, preferably in an accessible format, and even better it was supplemented with extra online material for instance [140Y, 643B]. Moreover, Marcus underlined that this would be useful for blind as well as sighted students [24B].

Sometimes the support material is not available in a digital format, but it could still be made accessible via a scanning [28B]. Sometimes the students experienced that the material was provided in a digital format, such as PowerPoint presentations, but was composed of drawings with very little or no text, making the material completely useless to them [140Y, 229Y].

This did not mean that teachers should not use graphics at all. In fact, in the Artificial Intelligence course Marcus justified the convenience of using graphs as a natural tool for explaining neural networks, a topic in the course, although it proved a limitation to him [1046B]. In this case the limitation is clear, but we also need to cover another aspect or level of accessibility, one that is less obvious. In the same course the teacher asked the students, as part of their homework, to do a neural network representation of the distribution of the buildings in the city. Marcus was unable to complete this task, as he did not have a spatial conception of the city, only of the position of his house, the shopping centre and a few other places [1049B]. Furthermore, as this was presented by the teacher in a graphically oriented way, Marcus was able to ‘grasp’ what the graph did, but he was unable to use it himself ‘in any sensible way’ [1046B].

In contrast, when we talked about mathematics Marcus commented on graphics:

> I know that blind people are unable to draw very well neither very good in mathematical drawings, but seeing something graphical can help you, believe it or not, it can actually help you if you see for example a coordinate system with a straight line. That is actually very helpful even though you may not be able to understand it, but if you see it you can say, “Ah, okay, that’s what it looks like, that’s what they want me to do.” [1098B]

Thus, deciding that graphs are necessary for all students, it is necessary to make the contents of these graphs available in alternative formats to blind students, just as it is necessary to inform them of which graphs are important. This was something Marcus said when I asked him whether the mathematical emphasis in the computer career programme created problems for him. His answer was clear:

> Actually yes, it depends on how well the teachers are prepared and how many materials you can get, and how good these materials are. [1096B]

Vicente shared Marcus’ opinion on how relevant teachers’ preparation is when it comes to blind students’ ability to study mathematics. He commented on the difficulties he had trying to translate a graph or test properly to Braille. He had the skills to study mathematics, but he got discouraged simply because of the limited accessibility [194Y].

In this connection the question is to which extent the teacher designed the class to accommodate Marcus’ needs? It seems to me that the answer is to a very limited extent. During class Marcus was excused to use the graphical interface for developing UML diagrams [1961B], but then he lost points in the final exam [1900B]. Another example was when he passed the course, even though he did not complete all his tasks. He explained that he received extra attention from his teacher, and she decided to let him pass.

> […] she said, "if I look at you compared with your classmates, they haven't giving me a single thing this entire year, if I look at you, I think it is so cool you are doing this, so you will get passed even though I am not sure that I should do it but you have a pass", and she did that, because I hadn't handled a singled mathematical thing for the entire year. It was impossible because I couldn't work with it, so we talked about it, we actually do it during the lessons some times, the extra things. [351B]

Here the question is whether Marcus had covered all the topics and how important were the topics he had skipped. Even though subjectivity may be present in any evaluation, there was nothing to suggest that Marcus' teacher did an objective evaluation of the contents not covered by Marcus to determine whether the topics in question were important for his future courses.

I would like to finish this section by reproducing a part of my interview with Marcus. I had just asked him whether his teachers were not interested in exploring the different accessibility matters in greater detail, taking into consideration that they had a blind student in their classes:

> ***Marcus:*** Yep, not too interesting. They don't have a clue about accessibility, even though I've told them again and again how important it is.
>
> ***Ronald:*** And nobody got interested on it ... I mean, having the opportunity to learn in the ground, they were not interested at all?
>
> ***Marcus:*** Nope, they thought that C# was enough.
>
> ***Ronald:*** Do you have a clue why?
>
> ***Marcus:*** A simple form of brainwashing done by the teacher, I guess.
>
> ***Ronald:*** So, you mean teacher induce them of not thinking about accessibility?
>
> ***Marcus:*** No, but they were not taught how important it was.

> ***Ronald:*** What do they answered when you asked them about the importance of accessibility?
>
> ***Marcus:*** Well, the trouble is that I am the only blind guy taking this course, so even the teacher knew very little about it ... and when I talked to the teacher about it, he couldn't grasp what I was saying. I guess most people cannot understand that. When I worked in groups, I tried to educate them as to its importance. [2095B]

A forced observation is that none of the approaches were based on solid knowledge of what is the best way to work with blind students, and the prevalence of ignorance, intuition, improvisation and, in some cases, disinterest was evident here [173B, 190Y, 1042B].

8.2.3. Are there enough tools?

I have discussed extensively and in detail blind students' use of tools and highlighted the tools they consider indispensable and the tools they dream of. But which of the tools do the students really use?

When Marcus said that it was important to have a 'coordinate system with a straight line' [1098B], he was not dreaming of something that was not available. For example, the support office at UNA has an embosser that can produce prints of these graphs. But this is just a part of the solution. It is necessary that teachers have familiarised themselves with this tool and learn how to design their graphs so that they can subsequently be embossed. In fact, all students, sighted and blind, need to learn how to do this in case they have to make a presentation, for instance, which they want the entire class to be able to follow. The organisation therefore must be aware that the equipment in question exists; they need to purchase it and subsequently maintain it.

This means that blind students mainly use tools that depend on themselves and which they can use themselves if teachers provide digital material or written material that students need to scan and make available for screen readers for example [24B, 28B, 36B, 140Y, 194Y].

Consequently, sustainability is another matter. Marcus could, for example, programme in Java,[24] but only via JAWS can his screen reader work with Java [53B]. Therefore, blind Java programmers face limitations, as they depend on JAWS to be compatible with Java; in other words, they depend on the use of a specific tool as a screen reader. But it could be worse than that. Just because information is available on a computer does not mean that it is accessible to blind people. As discussed above a PowerPoint[25] presentation can be completely inaccessible, just like texts with many diagrams or pictures with no supplementary explanations [350B] and certain software, like Axapta[26] that is used in Marcus' system engineering course [157B, 638B].

We would be making a mistake if we assumed that making the text available in audio format constitutes a satisfactory solution. The pace could for example be so slow that it makes this format useless for fast reading or for covering big volumes of information [354B].

8.2.4. Is the environment an obstacle for blind students?

The topic of inclusion in the environment is almost absent in all the interviews. Marcus never mentioned difficulties in the environment as something that had a great impact on his academic or general opportunities. It seems to me that he did not expect tools to help him move about; he relied only on his cane. And he reacted to the suggestion of a guide dog as something he really did not need.

Julio was more open to asking for help with regard to mobility, but as a general necessity and not in the educational environment in particular. Nevertheless, in the beginning the lack of abilities for moving about temped to Julio to enrol in a distance learning programme, so that he would not have to get out of his house.

[24] Java is a programming language created by Sun Microsystems.
[25] PowerPoint is a trademark of Microsoft Corporation.
[26] Axapta was constructed in collaboration between IBM and Damgaard, and it was later bought by Microsoft Corporation.

He was satisfied with the induction process, including the tour around the campus [51Y].

8.2.5. Preparing for the labour market

In some interventions the students revealed some of their projections for their own future and the future of their peers. I considered it important to describe some of these projections.

When Marcus talked about how important it is for software programmers or software engineers to be aware that ‘no one knows what type of user is going to sit in the terminal in the end’ [172B], the person could be blind or visually impaired or have other needs, he was worried about not having heard ‘a single thing about accessibility from the teachers, from anyone in the school’ [173B], even though he was in his third semester. One year later, when he was about to graduate, the importance of accessibility was still not included in the class in question. Marcus said:

> Well, the trouble is that I am the only blind guy taking this course. So, even the teacher knew very little about it. And when I talked to the teacher about it, he couldn't grasp what I was saying. I guess most people cannot understand that. When I worked in groups, I tried to educate them as to its importance. [2095B]

Julio and Vicente experienced something similar, especially in the course mentioned above where an invited teacher demonstrated techniques that might be useful in their future counselling jobs. The instruments this teacher used were too visual and made the blind students feel completely excluded from the class [218Y]. Situations like this one had further consequences for the students:

> […] in fact, all the situations were extremely visual and sometimes … the worst is … what you felt worst is the implication that, if you use this material, then you are good advisers, but if you do not work with them, you are bad advisers. Suddenly I felt … I do not know if she tried to say that, but I felt that to work as adviser we need all these papers [...]. She did not address the theme, for example

> [accessibility], but in fact she did not talk about education for the diversity, how to use an instrument like those with a blind student, or by a blind advisor […] and all of these instruments were too visual, only images and she did not get into that … is now that I am realising it … it is a pity because I should asked her why? [226Y]

Julio and Vicente went even further. They not only complained about the missing concept of inclusion, but also about the message they got from the lecturer: blind people cannot be good counsellors. Indeed, when the lecturer failed to make a reference to instruments that were accessible to them, Vicente remarked that she made two errors in her presentation on inclusion: the instruments were not accessible to her students and, even worse, she did not include in her teaching any instruments that her students could use in their teaching. The answer was clear to Vicente when he asked himself whether this teacher was trying to tell them that they would not make good counsellors.

The above interventions represent the feelings of all the students interviewed on the lack of inclusion concepts, not only for themselves as users of the practice, but also for their peers who should learn about these concepts for the sake of their future professional lives [174B, 2086B, 2095B]. Marcus stressed the absence of accessibility concerns several times; they should motivate his sighted peers to develop accessible software, but neither his teachers nor his peers were interested or willing to use the screen reader to understand some important considerations for the design of software for others [1042B]. For his final project Marcus proposed developing something that would be useful for blind students [248B]; he expected to be able to develop similar accessible products when he got a job [165B]: products that would be accessible ‘at least, to people like me’ [176B].

With these scenarios in mind I was interested in how Marcus saw his future, after graduation, and I was not surprised when he, for first time, revealed a lack of self-confidence. When we talked about him getting a job, I asked him what his expectations were, and he commented:

> Currently … just a job – I need some experience working with other people. I may be able to switch after some time if the job doesn't suit me ... The company my student counsellor is looking at has had blind people before me so they know something about it. It's always good to "begin" such a place. [1373B]

He was worried about how he would deal with colleagues. He has survived in the educational environment with little attention from his teachers (as he has expressed repeatedly), but he has received no training in how to deal with future users or clients. His projections about the future were circumscribed into the present context, like his needs to avoid GUI:

> Hopefully, it's a programming position. It was what it looked like. They specifically wrote that they needed people who would develop on their Cobol-system, and as far as I know, that language looks like C and it is text-based. I really look forward to it, if I get it. That means I can keep out of GUI programming. I'd like that. [1655B]

In fact, one of the first comments Marcus made concerned a first semester course and the excellent teacher he had had, especially due to the teacher's abilities to cover the fundamental topics of what a computer scientist graduate had to have, and Marcus understood that GUI should not be part of this basis [43B]. This statement could be validated from an educational point of view and in the labour market, where computer scientists can work collaboratively with other professionals who can assume responsibility for GUI, otherwise it could entail limitations in Marcus' chances of finding a job. In the end that is what Marcus meant when he said above, 'I'd like that.' However, even though he validated his own skills as a programmer [535B, 537B] and believed that he had so far learned what he needed to know to be a good programmer and a good designer and he had the communication skills required to interact with potential colleagues, the diagrams he referred to were precisely meant to ease the communication between 'technical' and 'non-technical' people.

> That this education has at least taught me, and it has always taught me some ways that I can talk to the others about "I think we should have this and this and this", but I would not be the one to sit down and draw a diagram for them. I would

> write in pseudo-code or something else, and they would have to draw the diagram if they needed one. [869B]

Therefore, even though he downplayed the relevance of the graphical interface, he was aware of its importance. There was little he could do, though, to solve this problem, and he instead remained hopeful that the tools he needed in this area would be provided [871B, 2134B].

The situation in Costa Rica was not that different. The treatment of accessibility matters in the career programme Julio and Vicente were enrolled in was not better than the one Marcus experienced in Denmark. When I asked Julio whether his teachers had addressed to him with any suggestions or tools for dealing with situations he might have to face in his professional life, his answer was:

> Well … personally … maybe in few courses, but it was in the form of "Who wants to comment?" then somebody raises the hand and gives us an opinion, but the teachers never did that. What I do is to use this spaces to reflect about how I could do it, but never are the teachers who show interest and ask me: "Why do you do not externalize what you are thinking?" […] or "You, due to your impairment, or your particular situation, tell us how you could work with this?" … The true is that teachers never have shown interest to know about this. So, at the end, you finish keeping your ideas for yourself, and thinking, hopefully someday I will do it pretty good […] I know that my situation is limiting me and therefore I will not be able to do wonders, but hopefully I will do it in the best possible way. [269Y]

Indeed, as Julio was saying above, he ended up keeping his ideas to himself, constructing his own reality and establishing by himself how he would work with his students. He concluded alternatively that he would use other not visually oriented instruments like 'forums from music or narratives, story narratives, dramas, group discussions' [240Y]. Essentially, he solved his problems using alternative techniques that were accessible to him, but this solution is subjective, it is not a formal conclusion made by the university and included in the curriculum in question. For instance, Julio did not consider the effect of these techniques on visually oriented students, and this might limit the student participation. When I asked Julio and Vicente about this, they were shocked; they were merely solving their own academic problems with the solutions proposed, but they had not gone further from to consider their future practice. Both of them admitted to not having thought about it; they would probably ask the counselling department for help. Vicente illustrated how he would manage this situation:

> […] for instance, now that I am doing my guided practice, if something like these show up, I would tell them, "Draw it, make a graph" … I do not know, if they learn visually, how they are going to externalize these learning … and they can use this drawing to remember what we have been done … I do not know, it just pop up in my mind, so, I may said that it would depend on the situation… we would need to improvise and take advantage of whatever we have at hand. If we already know that this person is visual, we should try to make the effort to find solutions to this person … if it shows up suddenly, we should try to find tools for it. [235Y]

I think Vicente is right. Any professional will need to face new situations and find solutions. I also think that it is evident that they will eventually find themselves in this situation; therefore, it should be covered in class, at least to provoke a discussion of the situation.

Finally, it seems to me that all three students are aware they do not have to solve everything. I think they are ready to face the labour market with enthusiasm and the conviction that they are able to cope with it [119B, 235Y, 247Y].

8.3. Are there situations related to blindness that need special attention?

In this chapter I have discussed situations from two or more perspectives, depending on my interpretation of the situations noted by the students. I have presented some of the difficulties the students have had to face, and I have presented successful histories of students who achieve their goals, demonstrating the viability of blind students who are capable of pursuing their respective career goals. Now it is important to describe these difficulties and identify whether they are a direct result of blindness per se and whether overcoming them equalises the opportunities of blind students and their sighted peers.

For instance, when we discussed Marcus' dream of becoming a programmer, we saw an enthusiastic student who prepared himself as well as he could, but how much extra work has he done? If he had been a sighted student, he would not have needed to take English as early and as fast as he did [13B], but in the end learning English gave him an advantage over his sighted peers whose English was not as good. Also, learning English not only prepared Marcus for studying programming, it also increased his chances of accessing information on the Internet, a useful skill for anyone today.

When I asked him about his perception of his possibilities at school and whether he has not over-prepared, he said that he probably had, and he argued on the subject of his preparation:

> […] if look it in the other way around, it has freed me for a lot of resources, I have a lot of resources that I can spent in more difficult aspects as the graphical things and diagrams in such, because most of the other things I know by hard, so it is actually good that I was well prepared. [197B]

Thus, from another point of view this extra preparation was probably important for his studies. He also recognised that his requirements were greater and that it demanded a lot of him to just sit 'at the school for the whole day, listening to the teachers, taking notes' [199B]. He said that it was difficult to explain, but the main difference between him and his peers is their sight, whereas he needs to grasp the same information via alternative and limited sources and process them in different ways [199B]. Actually, he argued that he needed a special tool:

> […] if a system could be developed, that set: you have a blind person sitting there, in a back sit; and we have a sort of... whenever the teacher type something in his computer,

> or does anything in his computer, it is transferred to your machine, so your screen reader can see what he is doing, for example if he is using notepad, writing something about source code, it will be transferred to your machine, so that, you won't have to take notes; you just have a copy of what he wrote in the blackboard, then you can focus more in what he is saying, and make the work, a little better. That would be one way to solve it, because it will free a lot of resources from you, because you shouldn't need to take notes and you don't have to ask others to take notes for you, you won't have to do it at all. [208B]

Even though this tool would be useful to anyone, I have to highlight that if the teacher writes something on the blackboard, none of it is available to blind students; that is why it is needed, not merely desirable. As this tool was not available in his classroom, Marcus used another more basic tool: his friends. In fact, he tended to sit at the back of the room (as did the students interviewed in Costa Rica), where he could get support from his friends without disturbing the rest of the class [212B]. Another way to get support from his friends was by chatting, and when more extensive discussions were required they met in the canteen for a cup of coffee [646B, 649B]. We should take into account that when Marcus uses his computer in class, chatting for example, he needs to listen to the screen reader and, at the same time, keep listening to the teacher [448B].

Another situation that requires special attention is when the students receive or need printed material. Marcus mentioned a place in Denmark that created DAISY books on request [31B]. This service was also mentioned by a doctoral candidate at Aalborg University with low vision impairment; she complained that the organisation that provided this service offered it to all blind and partially sighted people in Denmark and, therefore, you often had to wait in line for a long time.

Other difficulties related to DAISY books have been discussed above, like the pace of the recording and the audio manipulation, are more limited in scope [765B]. From my own observations during the interviews, I found it remarkable how much time Marcus spent trying to locate a specific DAISY CD, as he had not labelled them [255B].

The above-mentioned service usually concerned entire books. If the material was an article or another short text, the obvious solution was to scan the material; but this was somewhat time-consuming for the blind students, and Marcus wished his teachers would do this [24B]. For Julio and Vicente there was another option: UNA provided these services in all semesters to support their students with disabilities. Still, if it had to be done quickly, they had to do it themselves [131Y]. Indeed, even if they received some support, they still needed to make an extra effort compared to their peers.

Once again, mathematics is a point of discussion. As described in chapter 4, many initiatives support mathematics for blind students, and for most of these activities the material has to be designed especially for this purpose. Marcus's comments confirmed this. For instance, to evaluate a formula the parentheses are fundamental, and if they are omitted it could result in calculation errors once the formula is unfolded [345B]. Also, he complained about the quality of the books [1084B] and confirmed that mathematics could be a problem, depending 'on how well the teachers are prepared and how many materials you can get, and how good these materials are' [1096B].

Julio made no particular comments on this theme; he had always avoided mathematics, even before he became blind [190Y, 192Y]. Vicente liked mathematics, some of his teachers had even said that he was good at it; nevertheless, he concluded:

> I liked mathematics; actually I was told that I was good in mathematics, and I considered the possibility to study mathematics, but, because what you have said, the accessibility, I said to myself no, it is not possible, too difficult. Because along the secondary school, it was too difficult to have a graphic, everything is a pain, for example, my final secondary test was wrongly elaborated, and I needed to appeal it and I won the appeal. […] but I liked the mathematics, when I could understand it. When there were people able to explain it properly, I had nice experiences. [193Y]

As Julio lost his sighted at an older age, his experiences adapting to life as a blind person were more intense. He first intended to quit his studies, because he did not know how he could continue studying; he needed to learn how to do it without his sight. He tried to record all the lessons, filling up seven to eight cassettes, generating strong limitations as regards relocating the information he needed, as he was forced to review all the cassettes: a very time-consuming task. Also, it was difficult for him to obtain the information [65Y]. Finally he decided to go to the Hellen Keller Institute, where they taught different tools for overcoming new conditions like Julio's, academic or practical. He learned about screen readers, and he felt:

> […] an improvement in my opportunities and then I learned Braille and I saw that it was possible … then, I was able to take notes of the important things and I started to see that I had better access to studies and to information. [77Y]

After he had learned to use these basic tools, he felt motivated to continue his studies and use the services provided by the institute, such as access to computers with screen readers. Another initial decision was to enrol in a virtual programme to avoid contact with other students, to avoid compromises; he was afraid of how his peers would react. He got comments like, 'look, he is blind, he may be dummy', which undermined his self-esteem [77Y]. Finally, and after having met other blind students at UNA, he became more confident and chose to continue his studies [90Y].

8.4. Spaces for the participation of blind students

So far we have discussed many situations in which blind students and their integration in the sighted educational context seem central, and this gives rise to the question: How do the students perceive their own participation in this context?

8.4.1. The role of classmates

Marcus was very clear about one thing: 'the only thing that separates me from the others is basically the screen reader. Then I should be fully competent' [1028B]. But at the same time, he argued, 'One of the things that I keep wondering about is why there are no other blind guys but me that has taken this education. It's not very hard actually' [624B]. In fact, Marcus complained about his peers' lack of competences; they were not able to do simple things, like copy-paste, which he had thought anyone with an interest in computer sciences would know before arriving at university [22B]. He also complained about his group; they were neither able to understand what he did nor were they able to do anything different concerning graphical interfaces [129B, 146B]. Moreover, he compared himself to one or two other students: the ones who were very talented or always well-prepared [133B, 195B]. He explained that because he was unable to participate in other activities, like playing football or basketball, he was able to prepare more; he had more time in front of the computer to do many of the things that his peers did not have time for [548B].

In contrast, Julio told me about two of the happiest days in his life in connection with being a student at UNA. Both cases are good examples of the continuities and discontinuities of his participation in this educational context. The happiest day in his life had been the day be met his girlfriend. He has just lost his sight and he felt bad:

> […] the worst in the world … why me? I wanted to shoot myself away […] learn that a person believed in me as whole person, for me that was more than important, it was more than a help, more than a simple believe, more than a simple empathy, I believed that it goes beyond … she is not looking at me as a disabled person, then I think that was my happiest day. [279Y]

Even though this event is directly related to his personal life and the recovery of his self-esteem, not to his academic career, the impact it had on his participation as a student is obvious.

> […] she introduced me her mother and the whole family and I know them. The people sometimes say, "wow, what a courageous lady, what a family", and it is in these moments that you experience what people think regards the person with disability, even if they are studying. With frequency, people do not see these persons projected; they cannot see

> how a person can progress as any other person, and it gives me strength; it encourage me a lot, because it will demonstrate that a person with disability is a person as any other one, with projects, with motivation to study, a person with feelings and emotions. [283Y]

The day Julio calls the second happiest day of his life is related to working in groups. Julio explained that he had difficulties working in groups, because he sometimes had difficulties integrating as a person with disabilities; people do not always believe that people with disabilities can contribute. He experienced this and thought of dropping out, because he felt that no one involved him in the work. One day, after the teacher had asked the students to form groups, he was left alone. It made him feel completely excluded, but he decided to do the work himself. This implied that he would have to face an assignment alone, for the first time; he had to decide on the approach, the objectives of the project, the activities, do the coordination with the institution where the project would be carried out, and he would arrange how to get there. Previously, the situation had been, ‘Julio, do not worry, tomorrow we will meet in such place, you get there, and then, we include you in the assignment’ [297Y], as he said, but this was not possible anymore.

It was in this moment that he realised what he had lost in his education. He realised that he did not know how to prepare for a research project, how to define the objectives, how to manage and control his students group. He almost began to cry, when he realised that he would have to scan all the books he had to use for his theoretical framework. This feeling at having to face everything himself, with his disability, made him start to complain about everything: he had too little time; he could not do things any faster; the technology was not good enough; he had never learned how to conduct research. Why had he allowed himself not to learn this? ‘[J]ust because the people assumed them for me, is there when you live it, experience it, feel it, internalize it’ [297Y]. But he completed the assignment, and the second happiest day of his life was the day he was able to submit his research and present it to the class with success.

8.4.2. Obstacles for participating

We have already discussed the many difficulties the students have had to face in their studies; some of them could be overcome by different tools. Now I want to stress the situations that can limit their participation. For instance, Marcus was able to fill out the respective contents of the structures of a UML diagram, but he was unable to draw a diagram and follow existing UML diagrams [114B]. He was excited about getting a tool that would enable him to design and navigate through UML [778B]. Vicente also had problems with mathematic, even though he had certain skills in this subject. He avoided it, as he did not consider it possible or found it too difficult for him to do without depending fully on the teacher; this was based on previous experiences [193Y, 195Y].

The system engineering course was more difficult for Marcus, because the teacher used software with a low accessibility level [156B, 161B, 639B]. The organization course also entailed some difficulties, but the teacher supported him, especially with regard to GUI [43B]. Thus, the artificial intelligence course was even harder. This was so, Marcus believed, because the subject is better understood graphically [634B, 1046B], the teacher used this approach without giving good oral explanations of it [627B, 646B], and the exercises required that the students had an understanding of graphical or space concepts [1047B]. In the end, he was unsure whether the difficulties he had were a product of pedagogical elements or his own inherent difficulties understanding the subject [1046B, 1050B, 1057B, 1060B. 1063B].

The design of the curricula could also lead to limitations, because specific requirements had to be taking into account; for instance, not all screen readers supported the programming language [52B, 956B, 963B], and not all text books or alternative material is appropriated for blind students [348B, 643B, 1084B, 1096B].

Another factor that limited the participation of the blind students was, as mentioned above, if the material was not made available in an accessible format; even when they were able to access it on their own or coordinate the translation done by others this could limit their participation [24B, 28B, 31B, 36B, 42Y, 127Y, 131Y, 139Y, 229Y, 345B]. Just sitting in class required extra attention and effort of the blind students if they were to obtain the information provided by their teachers or others lectures, probably influencing their participation [208B, 212B, 214B, 218Y, 225Y, 228Y]. Listening both to feedback from friends or the screen reader and to the teacher also posed a problem [448B, 645B, 649B].

The most obvious differentiator, allowing a minimum of participation, is the availability of a computer and a screen reader. This is particularly relevant for the Costa Rican context (though not exclusively), as both items are expensive to purchase and upgrade (recall that in Denmark these and other tools are provided by the state) [57B, 59B, 65Y, 75Y, 139B, 144Y, 968B, 984B, 1200B].

In group work it was essential that students had the opportunity to develop a strong blind identity to counteract the easy solution from the groups to make a non equitable distribution of responsibilities, to avoid situations like the above-mentioned where Julio had to face a research on his own. In fact, this situation occurred because Julio had been assigned with trivial tasks in all previous group work:

> […] when you have to work in group, sometimes it is difficult that the group integrate a person with disabilities … Why? because people do not believe how much can you contribute […] because before that, when I worked in groups people said, "Julio, do not worry, tomorrow we will meet in such place, you get there, and then, we include you in the assignment", and then I had the activities were they consider you can do, because they did not think you can do more than that, like "think in activities", nothing else, and what is the difficulty to do that. Sincerely, these activities can be found in books, you only need to adapt them. But, when you must think what I am going to evaluate in my research? How can I define my objectives? In which terms? What have I learned until now to do it properly, to manage the students group? How can I control them? [297Y]

In the courses where programming was a requirement, Marcus always negotiated a division of tasks that left the graphical interface to his partners and the rest of the coding work to Marcus. This would sometimes stress his partners, because Marcus had to wait for them to finish the graphical interfaces, until he could go on with the rest of the task [152B].

8.4.3. Preparing for future participation

As universities are responsible for preparing students for their professional future lives, understanding how students with disabilities see their own future is one way for the universities to evaluate whether they live up to this responsibility.

Starting with UNA in Costa Rica, Julio argued that in his academic career, accessibility had been virtually absent, even if teachers mentioned it; it was part of a disarticulated discourse, it was never implemented [269Y].

Similarly, Marcus stated that his teachers were ‘not too interested. They don't have a clue about accessibility, even though I've told them again and again how important it is’ [2095B], and they almost never have addressed the theme [174B]. Apparently, as a consequence, his teachers never talked about his future opportunities [2086B].

However, the absence of any discussion of their future opportunities has not limited Marcus’ and Julio’s plans; they each had their own goals. Marcus planned to develop accessible software [165B, 168B, 172B, 178B], even though he did not know how to take people with other disabilities into account [173B, 176B], and Julio planned to have access or produce inclusive material [225Y]. Vicente, on the other hand, was afraid of what his teacher was trying to say, namely that blind people cannot be good counsellors [226Y]. However, he also said that he would need to improvise in situations that had not been discussed in his career programme [235Y, 240Y].

Marcus accepted that he would not be able to develop graphical interfaces [446B]. He will be able to work, because he learned what he needed to learn to communicate with others, and if someone needs a diagram, they can do it themselves [868B]. Indeed, this point should be analysed in-depth, if the fact that Marcus has given up on the idea of designing graphical interfaces, or using UML diagrams, could generate difficulties in his professional life [111B, 114B, 119B].

What really matters is that Marcus is aware of his strengths and weaknesses, and that he focused on getting a job that favours him: ‘a job somewhere, I’ll be working some Unix-based server or anything’ [896B].

> Hopefully, it's a programming position. It was what it looked like. They specifically wrote that they needed people who would develop on their Cobol system, and as far as I know, that language looks like C and it is text-based. I really look forward to it, if I get it. That means I can keep out of GUI programming. I'd like that. [1654B]

In fact, he has identified himself as a programmer, and as such he believed that his career programme had changed his perception of how specialised he should be in his work choices [450B].

In the end, their dreams are solid and encourage them to prepare themselves to continue fighting on their own. Julio concluded that regardless of the difficulties he will have to face he will succeed in doing what he likes best [247Y, 269Y], adjusting his working area to adolescents and adults expecting they would need less visual support [249Y]. Marcus said, ‘I like to write programmes, I like to see people use them and be happy about it’ [1094B].

8.5. Summary

In this chapter I have described the thinking, the feelings and the experiences of three blind students, not only during their study time at university, but also their current experiences in academia and in their personal lives. The data have being interpreted and presented, respecting the students’ points of view, as we have discussed the events accompanying their contextualisation; what Geertz (1973) has called ‘thick description’, adopted from Ryle (1968). The data presentation has been illustrated with context descriptions from different situations, providing more information for a better interpretation of the meaning and a more extensive understanding of their behaviours, easing the analysis and contextualization of the outsider.

In fact, Ryle (cited by Geertz, 1973) defines thick description as follows:

> […] a stratified hierarchy of meaningful structures in terms of which twitches, winks, fake-winks, parodies, rehearsals of parodies are produced, perceived, and interpreted, and without which they would not […] in fact exist, no matter what anyone did or didn't do with his eyelids. (Ryle cited by Geertz, 1973, p.6)

Also, the data were presented and organised to understand what it means to be blind in tertiary education, to understand the students' trajectories, how the educational environment influenced these trajectories, what is ignored, and how students' participation has been established in interrelation with the context, their teachers and peers, their past and their expectations for the future. That is aligned with Geertz' vision of understanding:

> […] if you want to understand what a science is, you should look in the first instance not at its theories or its findings, and certainly not at what its apologists say about it; you should look at what the practitioners of it do. (Geertz, 1973, p.5)

In this sense, following the inspiration from ethnography and using the thick description approach from this chapter, I have constructed solid data for analysis in chapter 10.

< CHAPTER NINE >

LEARNING FROM THE CONTEXT TO DESIGN FOR LEARNING

> *I do not believe that teachers are sacrificed neither are lucky when they have a person with disability in their classroom … in fact, are lucky those teachers who can determine which are each one of their students' disabilities. [606G, a teacher participating in the workshops in Costa Rica]*

In the previous chapter I focused on how blind students perceived their experiences as tertiary education students. Now I would like to understand how the teachers, as key actors in the inclusion process, perceive the students' opportunities to study at a university and how the first steps towards this state of inclusion could be taken. For this purpose I will use the data gathered from three of the four workshops conducted in Costa Rica. The format for these three workshops was discussed in the methodology chapter.

These workshops were designed with two objectives: as a tool for collecting data from teachers and students and as a potential first activity in introducing university teachers to a process of inclusion. In this chapter I will present the outcome of the workshops.

9.1. The design of the workshops

The three workshops, numbered as one, two and four in the methodological chapter, were designed to initiate the construction of inclusive environments, although they were also used for research purposes: to collect teachers' perceptions of inclusion at university level. The other workshop from the set (Taller visionario: Soñando con el futuro) was a future workshop designed explicitly to enrich the list of blind students' needs. This list was used as a supplement to the data gathered for the research, but it was also used in the last workshop to inform the teachers of the students' dreams, as an example of their own perspectives on blindness and their relation to the context. Therefore, the future workshop is not described in this chapter.

Each workshop was designed, following Wenger (1998), to allow the processes of participation and reification, to allow the emergent to take place, to provoke analysis between the local and the global and to stress the negotiation of participants' identities.

All together, the workshops were designed to aid the understanding of blindness and students' needs, allowing the participants to construct their own notions of inclusion. This was considered a key step in pursuing a more inclusive teaching practice at university.

The organisation of the activity into three workshops allowed for long periods of reflection between the workshops, enabling the participants to advance step by step towards the inclusive paradigm.

The first workshop was designed to negotiate the meaning of blindness. It started by providing teachers with experiences of being blind, facing everyday activities and basic difficulties inherent to this condition. Then attention was turned to the academic context, where the participants were confronted with the experience of having a blind student in class as well as the experience of being blind in a classroom (the latter was done by blindfolding the teachers). Subsequently, they were asked to imagine the students' needs, using the following:

A course they had taught as a reference.
Their recent experiences in the first part of this workshop.
Their beliefs, stigmas and informal information about blindness.
Their own teaching practices.

The participants were all university teachers at the School of Informatics and none of them had any previous experience with blind students. They were encouraged to negotiate their practices and views of blindness and reflect on how they might to reify their new understandings in the curriculum and their practices.

This reification constituted the basis for the negotiation that took place in the second workshop, where a teacher who had previous experience with blindness and blind students from different career programmes (none of them were from the School of Informatics) joined the teachers. In this workshop the students briefly shared their trajectories, allowing the teachers to renegotiate their reification of blindness and their notion of inclusion. In this process, as I will explain later, many of the teachers' opinions were demystified and they gain a better understanding of the needs of the blind students.

The last workshop opened a space for reflection, based on the results obtained in the previous workshops and the future workshop (students' dreams).

In the following sections I will describe in detail each of the three workshops. Having described the workshops I will subsequently present the data gathered from the three workshops.

9.1.1. Viviendo entre luces y sombras (Living among lights and shadows)

In the first workshop different real-life experiences were used as an introduction to blindness and its impact on the academic life. This was done in order to give the participants insight into the theme.

The objective of this workshop was to guide the teachers who had no previous experience with blind students and enable them to build their own concepts of inclusion based on empirical material.

9.1.1.1. The workshop design

The participants were teachers from the SI or Group 2, described in the methodology chapter. The Office of Disabilities Affair (ODA) helped facilitate the workshop.

The workshop started with each participant making a personal presentation and giving a brief description of his or her motivation to participate, followed by an activity called 'Experimentando la ceguera' ('Experiencing blindness'), which allowed the teachers to experience blindness through simple and ordinary activities in everyday life and in academia. The participants were blindfolded and invited to do some physical exercises, to serve themselves a cup of coffee, to put toothpaste on a toothbrush, to sign their name and to use a computer with no aid.

Figure 9.1. Teachers experiencing blindness.

The next section was called 'Hey!!! Tengo un estudiante ciego en clase' ('Ups!!! I have a blind student in my class'). This section was divided into two different activities. For the first activity I had asked a voluntary participant to bring an example of one of her regular classes to the workshop. The material she brought was for a lesson in the system engineering course, and it was based on a PowerPoint presentation.

Figure 9.2. Teaching blind students.

In the second activity I gave a diagram to a voluntary teacher (see figure 9.3). Her task was to describe the diagram to the rest of the participants, who had never seen it before, and invite them to draw the diagram on the basis of her oral description.

Figure 9.3. Diagram to be recreated by the listeners.

Then four courses from the system engineering curriculum were used to inspire the participants to think of possible advantages and difficulties that blind students following this curriculum might face and possible solutions to these difficulties. Furthermore, the participants were asked to classify, using colours, their findings with respect to:

- Possible advantages of blind students.
- Difficulties with solutions.
- Difficulties with high-cost solutions.
- Solutions that add value to all students due to pedagogy improvements.
- Difficulties without solutions.

Figure 9.4. Material produced by the teachers.

A summary of the information collected in this part of the workshop is provided in table 9.1. These results were reused in the following workshop, where the teachers received feedback from blind students.

Course	Difficulties without solutions
1-2	Curriculum overload
3	One blind student among 29 sighted students
4	Difficulties using the mouse as an interface
4	The screen has only two dimensions
4	Use and 'abuse' of PowerPoint in the classroom
4	The results of the programming process are shown graphically on the screen
Course	**High-cost solutions**
1	Use of specialised software
1	Translation from mathematical language
1	Management of mathematical notation
1	Individual attention to students
1	Specialised mathematical teacher in Braille
3	Graphical representations for solving problems
3	Specialised UML software for blind students
2	Tape recorder
2	Exploit students' abilities
2	Specialised software in the labs
2	Generate awareness of inclusion
2	Conversion of models to embossed models
2	Translating the material (presentations and texts)
4	Availability of embossers and Braille
4	To develop or find software for editing codes and a compiler for executing it
4	To establish a proficiency test to get enrolled in the career programme
4	Permanent assistance to each blind student
Course	**Solutions**
1-2	Feedback from teachers and students
1-2	Help from the teacher
1	Class material in Braille
1	Cooperation of peers
1-2	Cooperation of a teaching assistant

(Continued)

3	Proper training for students and teachers
3	Use of proper software
3	Provide proper environment
3	Support equipment
3	Use of proper material
3	Adjust the timing
4	Do not admit blind students into the career programme
4	Train all teachers
Course	**Solutions that add value to all students**
1-2	Mutual support for the students
1-2	Standardised courses
3	Curricular adjustments
2	Awareness of peers
4	Hire human resources who have specialised in blindness and special equipment
4	More time for teachers to plan their classes
4	Work with interdisciplinary groups – an expert in inclusion, a blind person with experience in programming
4	Start with a controlled pilot plan
4	Systematise information (to document) for research
Course	**Advantages of blind students**
1	Proficiency doing mathematical operations
3	Much practice – little theory
3	Team groups
2	Additive memory
4	Excellent graphic memory
4	Better concentration abilities
4	The other senses are more developed
4	Proficiency in coding and decoding different iconographic languages
4	Very good typists

Table 9.1. Teachers' perspectives on advantages, difficulties and solutions for blind students

Finally, the workshop ended with a short non-anonymous questionnaire containing two questions, facilitating reflection on the topic:

- Can a blind student study system engineering? Why?
- Would you be able to teach courses you have taught to a blind student? Explain.

Three of six teachers answered yes to the first question, arguing they have the abilities to do it. The other three answered no, based on the educational environment's lack of the required facilities. In fact, two of the teachers who said yes also mentioned the environment's need to prepare. Conversely, to the second question only one teacher, Julia, answered that she would be willing to teach her course to a blind student. The difference between Julia and the rest of the teachers is that she accepted the challenge a priori, while the others were reluctant, as they needed time to prepare themselves and the environment before accepting this challenge.

The first workshop – questionnaire

Teacher	**Can a blind student study system engineering?**	
	Yes/No	**Why?**
Sofia	Yes	She can have the required abilities and creativity.
Gabriel	No	We do not have the awareness neither the training in the teaching staff. We do not have the software nor the required equipment either.
Julia	Yes	They have the mental and physical abilities. The problem is in the school that is not prepared.
Isabel	No	We do not account with the necessary conditions.
Marcela	No	In this moment we do not have the technological and physical infrastructure to guarantee the student success, in the established time.

Teacher	Would you be able to teach courses you have taught to a blind student?	
	Yes/No	**Explain.**
Joaquín	Yes	But he should have very special conditions in infrastructure, materials, resources and training.
Sofia	No	I would need a workshop to know how to deal with these students and to prepare the material under supervision.
Gabriel	No	I am not trained for this. The course have too many students for giving individualised attention.
Julia	Yes	I will need to prepare myself and maybe I would need to teach it many times to achieve an acceptable performance.
Isabel	No	We would need to have the right software. For instance. Jaws, tools for diagramming, counselling, etc.
Marcela	No	How can I review a UML class diagram or a pseudo code, that maybe could be easy to do with Jaws, but not to do programs.
Joaquín	No	The School of Informatics and me do not account with the knowledge, neither the resources in this moment.

Table 9.2. Questionnaire answers from the first workshop.

9.1.1.2. Findings for the theoretical framework

Following the model of tensions described in chapter 6 on the social theory of learning, I wanted to learn about the perception that UNA teachers have on students with disabilities, particularly blind students. I also wanted to learn about their attitude towards dealing with a blind student and their preconceptions of the possibilities of these students. Moreover, I wanted to know how academia would adjust to these students, if at all.

My first contact with the group of teachers gave me inputs as to the process of easing blind students' process of belonging to a university community.[27] A goal for this workshop was to identify and describe the obstacles, barriers, stigmas, discrimination and ignorance that can affect the proper integration of blind students in a university community, given that the university community in question did not prepare in advance.

Another area I was interested in was teachers' practices. I wanted to explore how teachers see their own practice and how this could fit with the needs of blind students, identifying the breakdowns, the tools that they think would be necessary and the ones that are missing.

9.1.1.3. Relevant workshop observations

In the last activity in this workshop I asked the teachers to think about the problems that blind students might have in the system engineering career programme. I wanted to identify the burdens of the teachers if they had to face blind students in their classes, whether or not they were interested in offering them the best possible support. One group was biased, as the teacher from the ODA dominated this group, interrupting and filtering some of the other teachers' misunderstandings. Surprisingly, the results were not that different from the results of the other groups.

9.1.2. Aprendiendo con otra percepción (Learning with another perception)

In the second workshop the four groups described in the methodological chapter were invited to contrast the construction of blindness made by the teachers who had no previous experience with blindness with the reality of the blind students and the teacher who did have previous experience.

[27] By university community I refer to the group of teachers, students, support staff and any other person or group of people who in any way influence, participate, interact with the process of learning in university contexts. This concept is a weaker concept than the one used in community of practice, because in this case I do not expect the university community to meet any of the required conditions to be a community of practice. On the other hand, this does not mean that it is not possible that some university communities can constitute communities of practice.

9.1.2.1. The second workshop

After the participants had presented themselves and listened to a ‘motivation talk’ made by the facilitator, they were asked to form working groups for the activity called ‘Qué hace falta?’ (‘What is missing?’). Each group included a blind student, but unfortunately only one teacher with previous experience with blind students had signed up for the workshops.

Figure 9.5. Teachers learning from the students.

Choosing from the following topics the participants prepared a requirements list on the basis of the students’ experiences:

- Infrastructure
- Tools
- Human resource support
- Material resources

The objective of this activity was to produce in collaboration a single list based on the blind students’ considerations and the established teacher perceptions of the educational environment. This time I encouraged a discussion on artefacts in order to explore to what extent the negotiations would stay within this scope. Furthermore, the students had to try to catalyse the relevance of the infrastructure, different tools, human resources and materials discussed to thus determine the impact hereof on their opportunities for studying system engineering. The findings from this part of the workshop are listed in table 9.2. There were only three groups, and none of the groups chose the topic of tools, but the groups did mention tools into their categories. A designated speaker explained their results and led a discussion on the points that had caught their attention. In connection with this activity I pretended that a number of new concepts concerning inclusion and accessibility had been incorporated naturally from students' life experiences and teachers' previous professional experiences, giving newcomers an opportunity to continue the reflection process that had been initiated in the first workshop, now enriched by the natural requests of the students.

What is needed?
Infrastructure
• Elevators properly maintained • Labelling classrooms and buildings (audible, tactile) • Signalling reference points • More spacious rooms and labs • Ramps • Escalators with adequate barriers, considering safety requirements • Wider doors • Security systems • Maintenance systems • Adequate toilets • Furniture (chairs, tables) • Adapted keyboards • Software and special materials (Thermoform) • Braille printers and others • Digital recorders • Memory sticks • Virtual sites • Make UNA webpages accessible • Specialised centre with 'tiflo' technology and audible library • Resources portal • Specialised personnel
Tools
(This topic was not chosen.)
Human resource support
• To have a person that reads and guides the blind student on the subject of his or her career programme curriculum (first contact). • To form an interdisciplinary group to do in-depth interviews with the student to

learn about: his abilities, interests, requirements, expectations, difficulties, etc.

- To train the personnel in general (administrative and academic staff) and to sensitise them to the inclusion process.
- To have an office at the university level (such as the ODA in UNA) and another in the School of Informatics to offer general and particular support.
- To support the process of any student who wants to systemise the experience (as a thesis) to evaluate the progress and to make pertinent interventions on time.
- Each teacher must ensure the equitable inclusion of blind students in their workgroups.
- Develop an inclusion and awareness process with the students.
- Teachers should check whether the books and materials they plan to use are available in audio book format and give priority to them. If not, the books must be provided in advance, enabling the students to convert them to an adequate format.
- Technological resources must be available in flexible schedules to convert the material to another format: recordings, Braille.
- Teach the students to scan material and have volunteers or teachers repairing the material in question in order to get a 'clean' text.
- Ask teachers to transfer PowerPoint presentations to text to make them accessible for JAWS.
- Teachers willing to provide the material on memory sticks.
- Teachers should be available via telephone and email to explain any doubts about content.
- Peer support from blind and sighted students to help with mobility and orientation on campus.
- Political commitment from authorities to make decisions.

Material resources

- Openness, willingness. (Direction, teachers …).
- Cutting-edge technology.
- Technical support (infrastructure, personnel …).
- Develop specialised software.

Special comments from the researcher

This list has been translated as accurately as possible from the source posters prepared by the groups. Unclear concepts have been left in the way they were presented to illustrate some of the difficulties the groups had in the process.

Table 9.3. List of needs posted by the working groups.

In the second part of this workshop the following questions were used to 'trigger' the audience: Is it possible for a blind student to study system engineering? Why? What do we need? New working groups were formed, again making sure each group contained one student. This time the working groups were given the material listed by the teachers in the first workshop on the problems, difficulties and solutions that blind students might face at the SI. The groups now had to validate the difficulties and their respective classification.

Each group had to present their conclusions, and a final summary was produced in cooperation with the audience.

9.1.2.2. Findings for the theoretical framework

I expected to be able to collect a broader scope of information from this workshop, taking the opportunity to have a full set of participants and providing them with the opportunity to interact and learn from each other.

The workshop was planned to give the participants the opportunity to share their own experiences and discuss them in order to receive feedback from the other participants, thus generating a richer overview of the situation. The teachers from Group 2 contributed with the material and their thoughts on the scenario that students would face in the SI. The students were instructed to share their life experiences and thereby reject or confirm teachers' perceptions. The teachers in Group 3 had to share new perspectives on their classroom experiences. This process could identify perhaps not the specific tools that are required in practice to fulfil the needs of a system engineering student, but the tools that students are using in other career programmes in UNA. Also, the process could identify the tools that are unnecessary, because they were based on false assumptions.

I expected to start recognising tools used by the blind students in the Costa Rican context, particularly at UNA. From the discussion of what a problem or a difficulty is and what it is not, it is possible to gather information about the tools that students use to overcome some of the situations mentioned by the teachers. Some of these tools could belong to educational practice, whereas others might belong exclusively to the students and their adaptation to the learning environment.

As a natural consequence, if the audience was able to validate the thoughts, experiences and feelings connected to students' life experiences, it could be possible to add other elements from the social structure, revealing gaps in and in between the discourses, the culture and the inclusion process.

I also expected to identify facts that might affect the different students' identities: facts that might shape their identities, their membership or multi-memberships, their trajectories, their negotiability within and with other communities, and how they perceived their opportunities to succeed. When the students were validating their reality against the perception of the teachers, facts about their own identities surfaced, as they had to use their own life experiences to reject or confirm teachers' assumptions; therefore, they had to reveal parts of their own stories, their feelings, their culture, their membership and multi-memberships (Wenger, 1998).

9.1.2.3. Relevant workshop observations

From this workshop I would like to highlight that after reviewing the problems that the teachers had identified in the previous workshop, the students found that many of these problems were not problems at all, or the problems had already been solved by specific tools (see table 9.4). This could indicate that what blind students need to study system engineering is not necessarily aligned with their blindness and, therefore, this question has to be addressed in a systematic and structured process.

Some of the difficulties mentioned by the teachers (listed in table 9.1) that were invalidated by the students include:

Course	Difficulties without solutions	Students' answers
1-2	Curriculum overload	Blind people do not expect the level of the course to be lowered
3	One blind student among 29 sighted students	The course dynamic adjustments should never affect the rest of the students
4	Difficulties using the mouse as an interface	They do not use the mouse. If the software is accessible, they do not need it
4	The screen has only two dimensions	
4	Use and 'abuse' of PowerPoint in the classroom	They remarked that this would also affect sighted students
4	The results of the programming process are shown graphically in the screen	Partially true, if they need to evaluate the graphical interface. Otherwise, they only need accessible software
Course	**Solutions with High Cost**	**Students answers**
1	Use of specialised software	Need to be described
1	Translation from mathematical language	
1	Management of mathematical notation	
1	Individual attention to students	Even if it was helpful, it is not necessary
1	Specialised mathematical teacher in Braille	No, just rewrite the formulas in an accessible format
3	Graphical representations for solving problems	
3	Specialised UML software for blind students	
2	Tape recorder	Usually they have a tape recorder, but it would be helpful to have a digital one
2	Exploit students' abilities	Apply to every student
2	Specialised software in the labs	They only need the screen reader; they usually already have one and accessible

		software; not necessary with special software
2	Generate awareness of inclusion	It would be desirable
2	Conversion of models to embossed models	
2	Translating the material (presentations and texts)	
4	Availability of embossers and Braille	
4	To develop or find software for editing codes and a compiler for executing it	
4	To establish a proficiency test to get enrolled in the career programme	It was questioned whether the proposed test was for blind students only or for all students
4	Permanent assistance to each blind student	It would be desirable, but for general purposes, not for every course

Course	Solutions	Students answers
1-2	Feedback from teachers and students	
1-2	Help from the teacher	
1	Class material in Braille	Now they use screen readers more than Braille
1	Cooperation of peers	As any other student, maybe a little more
1-2	Cooperation of a teaching assistant	
3	Proper training for students and teachers	
3	Use of proper software	Just need to be accessible
3	Provide proper environment	Some examples were provided for other disabilities, such as adjustable tables
3	Support equipment	
3	Use of proper material	Just need to be accessible
3	Adjust the timing	
4	Do not admit blind students into the career programmes	They did not like this solution; but if it is impossible for a blind student, they would be resigned
4	Train all teachers	

Course	Solutions that add value to all students	Students' answers
1-2	Mutual support for the students	Apply to all students
1-2	Standardised courses	It is necessary for all career programmes
3	Curricular adjustments	
2	Awareness of peers	
4	Hire human resources who have specialised in blindness and special equipment	It would be desirable
4	More time for teachers to plan their classes	
4	Work with interdisciplinary groups – an expert in inclusion, a blind person with experience in programming	It may not be necessary
4	Start with a controlled pilot plan	It would be desirable
4	Systematise information (to document) for research	
Course	**Advantages of blind students**	**Students' answers**
1	Proficiency doing mathematical operations	They did not believe this was related to blindness
3	Much practice – little theory	Actually, it is easier for them to deal with the theory
3	Team groups	Not always easier
2	Additive memory	
4	Excellent graphic memory	No graphic memory
4	Better concentration abilities	It is the same for all students. It does not depend on their blindness
4	The other senses are more developed	When they need it
4	Proficiency in coding and decoding different iconographic languages	
4	Very good typists	This is probably true: a result of practice

Table 9.4. Table with teachers' perspectives on advantages, difficulties and solutions for blind students, commented on by blind students.

9.1.3. Taller de profundización: Obteniendo soluciones (Going deeper: Obtaining solutions)

In the last workshop the participating teachers were meant to work together, as a way to negotiate the reification of blindness, inclusion and tools as well as a step towards organising the concepts discussed in order to prepare for a future formal process, developing policies, infrastructure, materials, tools, training, adjustments and adaptations: that is, the entire scenario for launching the process of establishing reasonable levels of inclusion in the short term.

9.1.3.1. Activities in the last workshop

The first activity was the presentation of a teacher from Group 3, who talked about his teaching experiences with blind students in his classroom. I asked him to prepare a presentation where he would talk about his first impressions, when he realised that he had a blind student in his class. I suggested that he made references to the methodological adjustments to his classes and to evaluations in order to cover the students' needs. In addition, I asked him to comment on any new skills or knowledge that he had to acquire and to reflect on what extent his experience with blind students provided pedagogical improvements for the other students in the class.

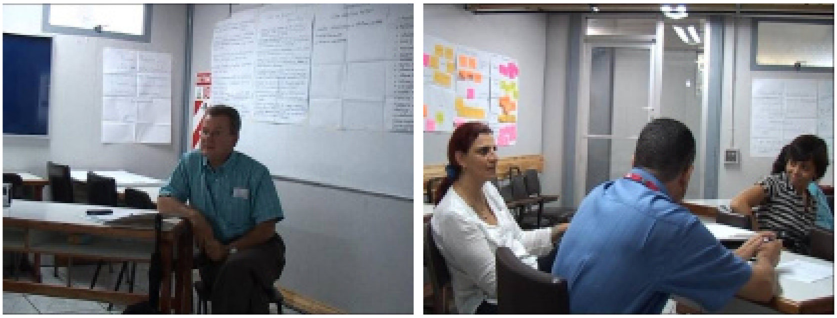

Figure 9.6. Teachers reflecting on what they have learned.

The second activity was called ‘Aprendiendo del aprendiz – reflexión sobre lo aprendido’ (‘Learning from the learner – a reflection on what has been learned’). In this part of the workshop a summary of the results of the three previous workshops was presented and used as motivation for discussing issues of interest to the audience. It was an opportunity to explore doubts, interests, worries, concerns, lessons learned, reflections, possible situations for students in system engineering and the actual opportunities blind students have for succeeding in this career programme.

The final activity was a general conclusion on the four workshops conducted by the facilitator. In also functioned as the facilitator in this connection and I used two instruments in this activity. Firstly, once again I asked the participants to fill out the reflecting questionnaire:

- Can a blind student study system engineering? Why?
- Would you be able to teach courses you have taught to a blind student? Explain.

It was interesting to detect changes in the teachers’ perceptions in this second questionnaire. This time seven teachers filled out the questionnaire. Julia did not fill out the questionnaire this time, but Adolfo and Claudia did. Six of the seven teachers said ‘yes’ to the first question, consistently pointing out that the problem would be in the educational environment exclusively; now they considered themselves more confidents in blind students’ abilities to cope with any difficulties they might face in the career programme (see table 9.5). The answers to the second question were consistent with the first one, except for Marcela’s answer; her answer to the question on whether she would be able to teach a blind student was somewhat reluctant: ‘I can try’.

Final Questionaire		
Teacher	**Can a blind student study system engineering?**	
	Yes/No	**Why?**
Sofia	Yes	Because they can have the abilities to understand the algorithms and the other career' themes.
Gabriel	Yes	We need more than tools, we need teacher disposition.
Isabel	No	There are some conditions missing.
Marcela	Yes	Because we can adjust to their needs. It will take time, but we can.
Joaquín	Yes	Because the blind do not have limitations, only just a condition.
Adolfo	Yes	Because any knowledge can be transmitted. Of course, it would be necessary to have the right tools to allow such transmission.
Claudia	Yes	Because he would need, as the others, to fulfil himself. He has the ability to learn, creativity and with the right support, he would cope his problems.
Teacher	**Would you be able to teach courses you have taught to a blind student?**	
	Yes/No	**Explain**
Sofia	Yes	Conditioned to have the equipment and the furniture they may require. Also that I got notified in advance.
Gabriel	Yes	It seems to me that we just need to do some adjustments.
Isabel	No	It is required resources, training and policies to enhance the inclusion.
Marcela	X	I can try.
Joaquín	Yes	I would need to give her individualised attention, and she should have some special conditions.
Adolfo	Yes	Because it is very easy to transmit abstract concepts, that allowed having an abstract systematic understanding, without using tools.
Claudia	Yes	I do not teach in School of Informatics, but in my researching courses, they could.

Table 9.5. Questionnaire from the final workshop activity.

The questionnaire activity was followed by an open, oral evaluation of the workshops, where the participants were asked to give their general opinions about the workshops and say what they considered the most relevant aspect of the workshops and what could be improved.

9.1.3.2. Findings for the theoretical framework

The main activity of this workshop was an open discussion on what we have learned and what we need to do next. The relevance of this workshop was to enquire into whether and if so how much we have improved our understanding of blindness and its relation to the academic environment.

Teachers were not very confident about being able to solve any needs blind students might have, but at least now they knew which kind of support they were likely to need.

9.1.3.3. Relevant workshop observations

Only one teacher with previous experience with blind students gave a presentation. The reason for this was simply that he was the only one who had agreed to participate in the workshops.

Throughout the different workshops I observed a tendency among the teachers to overprotect students with disabilities, providing them with an unhealthy environment that isolates them from the real world. The same teachers later tried to break this paradigm and push towards a more inclusive concept. For example, the teacher who had previous experience and who was a deputy at the time Law 7706 (1996) was discussed shared some of his experiences with opponents to the law project. This group of opponents included teachers of students with disabilities, who were afraid of moving children with disabilities out of the ‘protection’ of ‘special educational needs schools’ and into regular classrooms. He commented on how these teachers referred to their students as ‘my children’ – ‘What are they going to do in a regular classroom?’ – showing excessive protectionism, typical of the charity model.

However, at the end of the workshop series the teachers did not clarify what they needed in order to teach blind students, but they knew what they did not need. Also, they were prepared to work in the areas they identified as having or could have problems. They were able to better understand what it means to be blind, how to deal with students with this condition, how to communicate with them, how to ask them what they need as the first and basic step in the process of including blind students in the given career programme.

9.1.4. Workshop design criteria

The workshops were designed according to Wenger's dimensions of design (1998). I would like to make it clear that this design is just an artefact that could eventually be used in the inclusion strategy that is necessary to establish in the educational environments, particularly in tertiary education.

As explained above, the first workshop was designed to motivate a negotiation of blindness among the teachers who had no previous experience with blind students, to encourage them to construct their own reification of blindness; first by using their empirical knowledge, their imagination and their believes, and then by reconstructing them after having experienced blindness themselves.

This negotiation started encouraging the teachers to experience with artefacts and people, participating, negotiating new meanings of blindness, but leaving space for the emergent. An important result from the first part of the workshop was the teachers' reification. After this the teachers were faced with their local practice, and they were asked to imagine any difficulties blind students might have here.

During the second workshop the teachers had to renegotiate their reifications with the blind students, their own practices, their identities and their participation to bring about a new negotiation of meanings, identities and practices.

Finally, the goals of the last workshop were:

- To make it possible to renegotiate the current practice with the blind students’ practice.
- To lead to the negotiability of identities.
- To finally propose new reifications of blindness.

9.2 Blindness and inclusion from teachers’ perspectives

In this section I will focus on what the teachers said on the subject of blindness, without differentiating between myth and reality, and how these perceptions were transformed in the course of the workshops. It was interesting to see the prevalence of the medical model and, especially, the charity model in the first workshop.

9.2.1. Starting with their own reification

One of the first findings in this set of workshops was the teachers’ acceptance of the need to make adjustments to their practice, even though it was not clear how to achieve an inclusive practice. In table 9.6 I have listed some of the teachers’ comments, illustrating their concern with how to cope with blind students. They were clearly interested in overcoming their limitations and be able to teach blind students, and they were constantly negotiating their current practice and questioning how it could fit the students’ needs.

Reference	Teacher	Teacher comments
[4G]	Marcela	In this moment, as a teacher, it is possible for you to have to face a blind student in your class [...] and what is straightening is what to do if it happens to me … if I had a blind student in my class, I do not know yet what to do …
[6G]	Gabriel	I have had the experience of having students with disabilities and I have experienced certain difficulties because I had no previous training on how to cope with this situation. The student was hearing impaired.

[8G]	Sofia	Currently I have a student with a disability, he has a speech disorder … and this situation has motivated me to participate on the workshops, to learn how I can help these persons …
[9G]	Julia	[…] I had a deaf student and another one with cerebral palsy, and it was difficult to understand him. It was a very uncomfortable situation because I tried, as teacher, to help him as much as I could, and it was… in both cases, when I went to the classes, I remember that I sweated ... It was uncomfortable for both the other students and I, especially because there were students that did not understand the situation and they complained to him why he talked so slow; something that I did not think could happen among students.

Table 9.6. Teacher comments about having a blind student in class.

For example, Julia said:

> I am interested in improving my teaching skills and eventually if there is a blind student who wants to study, maybe we should have to say no … Why? Because … how are we going to deal with her/him in the lab, for example? [10G]

Here we need to recall that by this time the teachers were reacting with their preconceived ideas about blindness. The teachers were interested in how they could help the students orientate themselves in the classroom, giving them a spatial tour or treating them properly and avoid offending them [35G]. Also, they established the importance of keeping the class in the same order to not disturb the orientation of these students [25G, 26G, 44G]. The teachers were also concerned with how this would affect the rest of the group, as they assumed that students with special needs would demand methodological changes to the courses. For instance, one student would require an explanation of a graph, while the rest of the class just needed a quick overview to grasp the concept in question [57G]. They also wondered whether the vocabulary could generate communications barriers, since their mental representations related hereto might also be different [60G].

Beyond this point, the discussion turned to the necessity of preparing in a special way for the class, improving communication with all the students, including the blind students [62G, 67G, 77G, 83G]. Half way into the workshop Julia had a question:

> And who has this resource? And not only the resource, because I could be full of good intentions, but if I do not know how to do it better for a blind student, it does not matter the resources and the good intentions, at the end, I still will do something that the student will not understand. [64G]

Later, Joaquín proposed a more structured request to help the SI cope with the inclusion matter:

> […] human resources specialised in blindness as well as specialised equipments, teachers with paid time for preparing the classes in advance, to apt them to blind students. Also, to systematise and document the process for research purposes, in order to study and have a deeper understanding of this situation; interdisciplinary work with experts in inclusion, with experienced blind people to train our human resources, and share their experiences to help our future blind students. [236G]

As part of the justification for this preparation, Marcela mentioned that she had started to speak at a slower pace during the activity that she participated in, until she realised that the audience could hear perfectly well. They did not need to read her lips, because they were blindfolded [270G]. This fact reveals a misunderstanding as to how to act in a classroom with blind students.

Claudia went even further, when she talked about an approach that could be used with students with disabilities. She proposed entering into a kind of dialogue with the person the first time one met him or her:

> […] "there are some topics that will be easier for me to manage with you [the blind student], but there are moments when I am going to need your support, because in this case, the person who is handicapped is me, because I have not

> grown up and I have not had a blind person near me, in order to have developed myself as I should have". [...] It gives the person the advantage to say, "Good, I have the opportunity to be protagonist of my own learning process". [114G]

Similarly, Claudia explained the slogan 'Nothing for us without us', which means that we need to ask people with disabilities what they need if we want to meet their needs [107G].

During the activity where the teachers were blindfolded in order to experience blindness on their own bodies they commented on their feelings (see table 9.7). These reactions are important, because they brought out any fears people might have. These fears might easily be translated into limitations: that is, limitations caused by the condition of blindness.

Refs	Teacher	Teacher comments
[16G]	Claudia	I heard voices but I could not incorporate any of them, then I felt alone, as inhibited. I felt safe sat there. Therefore I did not offer myself to participate in anything, I did not do anything. I said I will stay right here, completely static … alone and static ...
[19G]	Marcela	I hate not to see. It is something that I have had inside me for a long time. During outages, I lose control, it is something that makes me stay in a place and I do not move from there … but I also perceived that I could hear much better and I was able to locate the context.
[20G]	Julia	I felt awkward and insecure to do something that could hurt someone. Also, well, I did not feel too bad because everyone was blindfolded but I felt as if I put myself in the place of a person, that I could not know who is watching me or is somehow judging me…
[24G]	Sofia	[Regarding the journey she had to make as part of the exercise] The event of going up to there, I perceived it as eternal, but then, maybe with more confidence after being able to write in the paper, I did the return with greater calm …
[32G]	Julia	But you know, as much as I close my eyes, I could feel more from the context…

Table 9.7. Comments from the teachers when they were blindfolded.

This supposition was underpinned by the next activity, where the teachers used the course descriptions they had brought to the workshop to establish the following:

- Advantages that blind students may have.
- Difficulties without solutions.
- Difficulties with high-cost solutions.
- Difficulties that do not depend on a particular infrastructure.
- Difficulties with solutions that provide added value to the pedagogy.

The result of this exercise was, as pointed out by Claudia [250G], a long list of difficulties with different classifications and a very short list of advantages (see table 9.1).

Throughout this workshop the teachers were prone to jump to conclusions on what students might need and the respective implications for themselves, for the students, for their peers and also for the environment preparation.

Joaquín suggested the usefulness of finding or developing software that would allow code editing; subsequently, the compiler could execute this code and inform the user of the quality of the code and whether the user had made any mistakes [206G].

Among the proposed solutions was also the solution to simply avoid admitting blind students into the informatics programmes, based on the fact that the school was not prepared to receive them. However, the teacher would not recommend this ‘solution’, knowing that it would be incorrect behaviour and against Costa Rican laws [211G]. Finally, this option generated extensive discussion. Claudia remarked:

> The truth is, we understood that the easiest option and what has been done until now, in many occasions and schools is that when a child with a big challenge asks to attend the school, they answer, “Look, what a shame, we are sorry, but we are not prepared for this”, and they close the door to the

> blind child, to the deaf child. The university could do the same by saying, “In this university we enrol blind people in certain careers, deaf people in others …” [211G]

They also mentioned possible individual answers from the teachers:

> “If you enrol a blind student, I will not teach that course … because I will be frustrated, disabled, I do not want to experience that … I am too old for this, to start experimenting with this … so please, give me another course where I do not need to deal with this” […] and there are teachers that have said, “I do not accept this in my course”, and they accepted their lack of skills, “I cannot do it, I am stupid, I do not want to do it, I feel bad … I will frustrate him”. What they are really saying is, “I do not want commitments, I do not want to complicate myself, and I do not want to accept the challenge …” [211G]

Moreover, Julia speculated about whether blind students, at least in Costa Rica, would want to study informatics, arguing that they are already convinced they cannot do it, even before someone has told them ‘no’. This is so because there is no infrastructure and no available material [218G].

Similarly, Sara mentioned some problems she had detected among the teachers. She said that the teachers, to varying extents, had focused on their own disciplines and that they had objected to changes to their environments, arguing that existing environments represent what students need to learn from the discipline [108G].

These teacher and infrastructure shortcomings were not the only worries Julia had. In the system engineering courses the students need to do a project in a company, and Julia worried that the companies would not be prepared to accept blind students in the project [223G].

Regardless of these arguments, Julia ended with a vote of confidence to the workshops:

> I think these activities are in this school, I may say, extraordinary, because we never … This is a good starting line, we are building ramps. What we have talked about

> ramps for those using wheelchairs, but these are the "ramps" that we need in our School and we have not seeing before. We need to ease the learning and other things … and this activity has been very useful for me. [276G]

9.2.2. From myth to reality

When the students came to the classroom during the second workshop, their very presence, talking and exchanging experiences, made some of the teachers' myths disappear. Simply observing the blind students' independence and the fact that they had no problem participating in the workshop dispelled some of the teachers' fears of how they should act and talk to them. Furthermore, the teachers experienced the protocol that was established when one or more blind students were present and learned that this group was not that different from any other group of students. This observation debunked many myths.

As the agenda for this workshop had been provided in Braille, teachers learned how fast and easy the students can read Braille. And when Patricia, one of the invited students, started to use her laptop, some of the teachers moved closer to her to see how she managed to use a computer, learning about JAWS and screen readers. Finally, after talking with the students in groups and discussing the problems that had been established in the previous workshop, the teachers' concerns had changed significantly.

Now they were more concerned with the social structure and the support the students required from different authorities, probably because the tendency to provide assistance still prevailed. Ernesto illustrated this prevalence, when he told the rest of the group how the support for blind students had changed. There used to be special schools and classrooms for children with disabilities, but today the role of these institutions has changed and instead they provide support to students, to regular schools and to teachers [304G].

Claudia proposed to raise awareness in students and university staff, administrative and academic, of inclusion matters in order to encourage equal inclusion [308G]. Marcela was more emphatic, asking for policies from school authorities, defining guidelines that everyone had to follow to help solve conflicts when a teacher decided not to take part in the inclusion process [335G].

Claudia also argued that institutional authorities should provide support at university level – she mentioned the ODA at UNA – offering general and particular support, respectively. These offices should have the technological resources and flexible schedules to provide access to format conversion. Such services should include courses in scanning techniques and voluntaries or teachers who could help 'clean' and refine the scanned documents [309G]. Another service that the university office should provide was a timely notification to teachers who had students with disabilities in their classes, especially hidden disabilities, to avoid repeating Marcela's recent experience: a student had dropped her course, because Marcela did not know about this student's disability [340G].

At this point the teachers were more critical of their roles and their perceptions of students' needs. Adolfo, the teacher who had previous experience with blind students, said:

> […] the task of the teacher is to teach, more than to help. And teachers should understand people with disabilities as people with an exceptional capacity to incorporate knowledge, to systematise them and to project them to their daily life in very different ways […] and that, it is difficult, because nobody thinks about it, and you think about it when you are facing a student with disabilities. That is when you need to find solutions. Therefore, the question you were asking should be in the opposite direction. For example, the School of Informatics, what do they need to do in order to have explicative instruments, clear enough to make possible for a blind student to appropriate the concepts and teachers can teach them. [298G]

Adolfo posed an important point. These workshops pretended to stress the perception of the teachers and the university in inclusion matters. Trying not to focus on any expected teacher position, the trigger for these workshops was the question: Can a blind student study system engineering? I may say that the teachers understood that the question should be turned towards the context and not the student. We may recall that this researcher underwent the same process before starting the research, as was explained in chapter 1. Thus, the fact that Adolfo concluded on the same point was not surprising. Now I will revise the question that inspired this research: How can the School of Informatics prepare to receive blind students? This question is aligned with Adolfo's suggestion.

Claudia also commented on situations that could reinforce the importance of these students having university students' attitudes. This comment was made when Patricia offered to take notes on her laptop during the second workshop. Claudia commented in response to Patricia:

> [...] the feeling transmitted to the rest of the students is that you are trained to do these kind of things, but not to propose ideas, to discuss nor to fight for your ideas … Therefore, in that sense, it is important to have a facilitator who is aware of this kind of things to avoid them. It is very common this happens. The students offer themselves to do something that they know how to do very well, due to obvious reasons, and to avoid difficulties. If the facilitator allows it, at the end of the career, the student ends up as an expert typist, but you have not expressed your opinion, you have not fought for your ideas, and the same peers say, "Let's bring Patricia to our group, because she is very good typing". [302G]

In this sense, the teachers started to negotiate their reification of blindness and renegotiated their practices and the practices of blind students. They had become conscious of their responsibility to incorporate the blind students. The teachers had to be aware of the state of equality in the work groups; learn to communicate naturally with blind students on any topic, 'as we are doing it now' [310G]; to examine whether the books used in the course in question are available in alternative accessible formats and look for one. If it proved impossible to find or substitute them, they should at least provide the book or parts of it as well as any PowerPoint presentations in advance in order to give the student time to convert them. On the other hand, the students need to play an active role in determining their needs, anticipating their requirements, finding opportunities to talk to the teachers and explain their condition to them [305G, 310G, 344G]. In sum, it is clear that solutions needed to be negotiated together, because, as Adolfo remarked,

> The student is not going to say, “Give me such things, otherwise I could not learn”, because it is unnatural. [305G]

Therefore, after the teachers had experienced blindness, imagined possible problems and solutions, renegotiated meanings and practices, they moved on to playing their roles as teachers. They considered how they could do a better job and teach in ways that would work for all their students, understanding the differences among all of them. But they had still not found a way to solve this.

They were also more accurate in pointing to areas that needed special attention, such as: tools for dealing with UML methodology; creating a repository for required material that was not available in accessible formats, but had already been converted elsewhere; tactile and audible signalling throughout campus to ease blind students’ mobility; more spacious classrooms and labs; accessible university websites and systems; and specialised centres equipped with embossers, Braille printers, scanners, etc. [311G, 317G, 323G, 326, 329G, 336G].

They also concluded:

> The inclusive paradigm says that the disability is in the environment, in the context, and this situation is setting barriers. As it do not provide a laptop, a basic tool to type equally; therefore, if a person with a disability has the assistive appliance that needs, this person would function exactly as we do. [363G]

Still, however, they were uncertain about how to do it.

9.2.3. After reflection

In the last workshop the participants reviewed the material generated in the previous workshops, including the list of dreams obtained from the future workshop with the blind students.

The reflections do not point in one direction. Since Isabel was still concerned with the resources and institutional policies [678G], Adolfo was emphatic in addressing, from an academic point of view, that teachers with special attitudes, not policies or discourses, had to adapt to the students' circumstances, 'varying in interests, signs, in their shyness, their self-assurance, all of them are distinctive elements' [598G]. What Adolfo said was that policies should merely address the general management of the classroom and the curricula, which should be formulated by each school individually, stimulating teachers' dispositions to adapt to the available resources [598G]. He also reflected on the fact that when the inclusion law in Costa Rica was under discussion, an important group of primary and secondary school teachers asked how they would be compensated for the extra effort. His opinion about this was:

> It should not be a special effort, as it was with our children, the first thing we need to do is to recognise their differences and acknowledge them as absolutely natural, and that is the same we should do. [600G]

The group also discussed the prevalence of social construction on discrimination, not only concerning people with disabilities, but also other groups, including gender discrimination. This aspect was considered as something that builds barriers that are difficult to break. Again Adolfo's response was that it is possible to overcome these precisely because they are social constructions; one simply has to change and inform society. So far it had been the other way around: people with disabilities had had to overcome their own disabilities, which were usually interpreted by other people as belonging exclusively to them; and therefore, other people did not have to consider their role in this matter. '[T]hey [the students] have to get used to their own disabilities, generally inducing people around them to also get used to such disabilities' [606G]. Adolfo thus emphasised the significance of the teachers' role in fostering acceptance in the classroom. This did not mean that teachers with students with disabilities were unlucky; this was something that was frequently discussed. In fact, he said, 'lucky are those teachers who can determine what each their students' disabilities are' [606G].

Adolfo's position was not completely clear to some of the other teachers. Marcela asked whether the teacher had to adapt his or her classroom to the students. How are standardised courses going to be taught? She mentioned that 14 groups of students took the basic programming course and said: If only two of them have students with disabilities this means that 12 groups will not require methodological adaptation [613G], and this might entail that the students from the two groups which do require adaptation might experience that the course level has been lowered [599G].

Adolfo continued his explanation. He clarified that such adaptation should never entail lowering the level of the course; that would mean going against educational principles [614G]. What it meant was that teachers simply had to spend more time making sure their teaching was understood by every single student in class:

> […] therefore, what I am proposing is that teachers need to be better teachers. And there is an important topic when teachers become learners from the learners, thus they can develop better teaching abilities. [614G]

Claudia commented that if that did not prevail in their context, it could limit blind students' opportunities and probably cause many students to not finish upper-secondary school and consequently not go on to university. She said that this was something that started in primary school (from 6 to 12 years old), where teachers overprotected students with disabilities and gave them more attention. During secondary school (12 to 17 years old) these students then had to face five or six different teachers, instead of the one in primary school, and their learning environment started to become more complicated; many even graduated without having fully accomplished the academic requirements. She believed that this was the main reason why there were only few blind students at university level [642G]. Adolfo added that this fact required special attention, because it meant that blind students had passed through a kind of filter, passing those with determination and academic excellence, which meant that these students should not have any problems following any career programme they desired [643G].

This takes us on to the next step. This discussion might suggest that determination and academic excellence on the part of the students and a proper approach on the part of the teachers should be enough. Claudia added three other categories from the point of view of the institution to these requirements:

1. The relationship between teacher and student.
2. Technological support.
3. The curriculum, contents and methodological strategies. [656G]

Adolfo explained that his previous experience with blind students was in a discipline dominated by intellectual discussions, and he did not believe that he required special instruments [621G, 656G]. But when the learning does require the use of particular instruments, the schools had to prepare to incorporate the instruments and adapt to meet all students' needs. This was the spirit of the 7600 Law, especially for public organisations; it was not enough to claim that one's budget did not enable such investments [607G]. Indeed, here is a conflict of interests. Claudia says:

> […] where the Government prefer to invest to give meaning to the statistics? It will not be in that 10 per cent of the population classified with disabilities. Now, if we want to accept blind students here [in the School of Informatics], they will need the technology we saw in the previous video … students will need it. None other disabled group has such benefits from technology and none of them has that amount of technology. It requires an important investment from the university… then; they will start to ask … "would it worth that for two or three students, we do such investment, when we still have not solved the problem of having water seeping, or not having enough parking slots for the teachers?" [610G]

In contrast, Adolfo highlighted how the Ministry of Education showed great capacity to adapt to the law, incorporating students with special needs into the regular flow of the schools throughout the country, even in schools that had a single teacher for the six primary levels. Schools received the necessary support from specialists to facilitate the incorporation of these students. Then he invited us to be less critical, and he encouraged us to learn from what had been done, learning from one's own and others' experiences, trying to find a way to move forward. He emphasised the need for solutions, but did not necessarily focus on JAWS, although he did clearly recognise its importance; this thus had to be a matter that had already been solved [622G].

In the future workshop Costa Rican blind students dreamed of what they called collaboration hours with other students who could support them in different tasks. When the teachers reviewed this dream, Adolfo commented that this kind of support should come from peer relations and should never be institutional; he argued that if it was necessary to assign somebody to help another student, it would imply highlighting the disability of the student, and that would completely oppose the notion of inclusion. 'It is important not emphasise the differences of the person, because that person is different as well as you are' [649G].

In a way this also answered the question that Marcela had previously asked Adolfo, as to whether there was any special awareness in his classroom. It was also important to highlight the relevance of working with the students [612G], as such awareness should be addressed to ease their participation and supervise the proper integration of the students in the flow of the class.

After these comments the teachers suggested that an executive summary was drawn up for the university authorities, noting a number of the suggested solutions that would be easy and cheap to implement [681G]. Claudia was more direct, suggesting that such a summary should be addressed to the ODA project, as she considered the role of this office too protectionist. Claudia recognised this conclusion during the second workshop, where she and Joaquin were working with one student, trying to understand what she needed for studying. Sara interfered in Patricia's participation, telling her what to say. Furthermore, she claimed that the role played by the ODA, scanning and preparing material, giving students unconditional attention and helping them solve their problems, distanced the students from the reality they needed to construct: that they were at university and that they needed to become self-sufficient and, thus, contribute to breaking the stereotypes related to their blindness [682G]. Adolfo referred to this by using the word ‘patronising’. Nevertheless, he believed that the ODA was a very important initiative for establishing support for these students, and he suggested that the results of the workshops could help revitalise the ODA, make their efforts more tangible, providing only basic equipment for the students and changing their attitude to give the students a greater sense of independence [684G].

9.2.4. Teachers’ conclusions about the workshops

Claudia made a call to reflect about our own behaviour. Although we had discussed what we had to do to ensure inclusion, the teachers kept returning to the problems and how to solve them. She identified the participants as the disabled, because everyone (including herself) was afraid, generating resistance to change and unconsciously boycotting this initiative, because ‘it is too difficult, too complicated, how are we going to do?’ [630G].

Also, she reflected on two aspects of the workshop experiences that had brought the participants out of their comfort zones:

1. Nobody had previously asked themselves why students fail courses, and no one had felt remorse just because the student did not have a disability.
2. To think, in the moment, when it is necessary to face a student with disabilities and demand that he or she works harder or compromise or improve his or her group work, in the same way a teachers do with any other student. [630G]

Another conclusion from Claudia was that we were able to move forward in these workshops, because the teacher group was relatively small, but if the group had been bigger, we could not have progressed as fast [630G]. Marcela agreed; she was also concerned about the other SI teachers’ low interest in participating in this kind of activity [676G]. However, she was very satisfied with what the workshops had achieved, and she thought the process had been useful for clarifying teachers’ ideas about blindness, demystifying many myths; and she said that she had learned to see blind students the way she saw other students: as individuals with strengths and weaknesses. She felt that blind students studying informatics was more feasible than she would have thought before the workshops [674G].

Isabel concluded that the task now was to bring what we had learned into practice and find out how the university could support these initiatives [678G].

Claudia also evaluated the workshops from a methodological perspective, and she stated that what she had enjoyed the most was that these had been actual workshops:

> It is frequent that we are invited to workshops where the facilitator just talk and talk, and just give a lecture. Indeed, the purpose of these workshops was to obtain the maximum possible information from us, and it was what you achieved, that we voluntarily and declaring our ignorance and our knowledge about the theme, we could express it and you collected it systematically. […] I loved the approach you gave to the workshops and that you are giving to your work, "I am not coming to give solutions; I came to see what we can do, what we have, what you know or what we can achieve if we are together …" I learned from the methodology of the workshop. Indeed I have to do a work in the next days and I am thinking to use this structure you have used, because I think that in just few hours, you obtained a lot of information from the people. [679G]

Claudia commented about the workshops that it would have been a good idea to have some sighted students, from different levels, participate, getting their perspective on matters in the end, as 'they are going to be permanently part of the process' [679G].

She also commented on the qualitative difference she recognised in the researcher after just two years. On the basis of her recollection of conversations she had had with the researcher before he left for Denmark, she believed the discourse had changed from a standard discourse of someone who knew about disabilities from basic experiences to a discourse with extensive knowledge of the theme. This entailed that any other teacher with similar interests and capacities could also do it, for instance the teachers at the School of Informatics [679G].

9.3. Summary

The designed workshops resulted in a valuable tool for achieving both objectives: initiating the inclusion process and constructing data for this research. As the objective of this research was not to provide such a tool for inclusion, this chapter has not analysed the workshops in sufficient detail to evaluate the workshops as such a tool and to propose improvements or corrections; this could be a subject for future research projects.

As a research tool the workshops soon met the different objectives. It allows us to evaluate the state of the art of inclusion. Firstly, we were able to see the impact and positioning of the ODA, allowing an evaluation of its degree of influence. The teachers felt motivated to propose suggestions for improving it. Then it was confirmed that the educational environments tend to react after they have to face the enrolment of a blind student. Finally, but not least, we were able to validate that the educational contexts are not prepared to receive blind students; they cannot adequately meet their needs.

From the teachers' perspectives the workshops were a great experience. A group of teachers demonstrated their vocation in teaching their students, including the possible incorporation of blind students into their classrooms. However, it was also demonstrated that interest and enthusiasm are not enough. A designed, guided, instructed and sometimes forced process is necessary to ensure a successful inclusion process.

In fact, some conclusions derived from teachers' participation included the need to enact policies and regulations to proactively ensure the inclusion not only of blind students, but of any student with disabilities.

Another conclusion from this part of the fieldwork was that the teachers' perceptions of the difficulties of blind students were often the product of prejudices and ignorance, as discussed in chapter 2 (Clements & Spinks, 2006). Therefore, as soon as we extend our knowledge of blindness, these perceptions and prejudices tend to disappear. Even though teachers did not show any explicit prejudices, their difficulties understanding blindness and how the students coped with their studies limited the students' opportunities. As soon as the teachers learned how these students participate in tertiary educational environments, they were prone to translate those difficulties into their own abilities, rather than focus on the difficulties of the students.

Finally, I could argue that this chapter provides a great complement to the students' views discussed in the previous chapter, providing a more comprehensive view of the educational environments, which will be discussed in the next chapters.

< CHAPTER TEN >

BUILDING KNOWLEDGE

> *[…] it is in these moments that you experience what people think in regards of people with disability, even if they [people with disabilities] are studying. Often, people do not see them projected in real life; they cannot see how a blind person can progress as any other person would. This gives me strength; it encourages me a lot, because I would like to demonstrate that a person with disability is a person just like any other one, with projects, with motivation to study, a person with feelings and emotions. [283Y, Julio, Costa Rican student]*

After presenting students' experiences and teachers' perceptions and after working with theories of blindness and social theory of learning, the goal of this chapter is to create a basis for understanding and working with inclusion in the learning process, providing a framework for easing the work, discussion and analysis of future solutions towards an inclusive environment in informatics schools and other university career programmes.

So far we have discussed concerns, fears and discriminations in connection with blindness, focusing especially on blind university students. Furthermore, we have described the success, opportunities, determination and enthusiasm experienced in this context by teachers and students. And we have recognised the awareness, effort, interest and compromise of both students and teachers in building a more inclusive environment. After discussing these situations, reflecting and collecting data systematically, the challenge is to explain this data, using a solid theory, to provide a working framework which the reader can use to systematise new proposals and to supplement the currently offered solutions, which are mainly based on adaptive perceptions.

10.1. Continuities and discontinuities in the educational environments

The data collected have revealed continuities and discontinuities in the educational environment, in the inclusion discourses, in the vision of the support provided, in the support expected, in opening opportunities, in the design of the environment, in easing students' sense of belonging, in providing time and space for negotiating practices, meanings and identities – in the previous and current students' preparation, among others.

To discuss these continuities and discontinuities I will stress the findings of my fieldwork, using the reconceptualisation of Wenger's model presented in chapter 6.

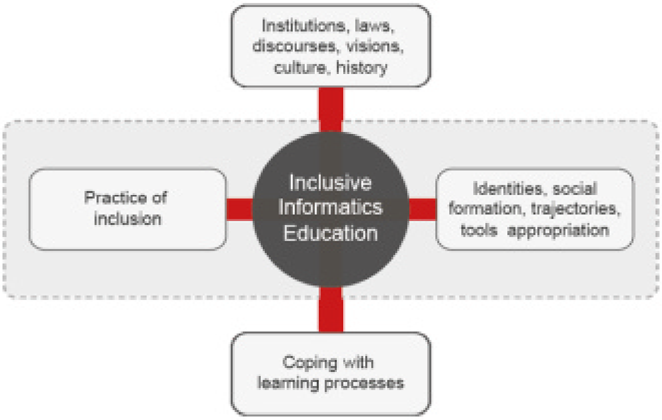

Figure 10.1. Reconceptualisation of Wenger's model of social theory of learning.

10.1.1. Social structures, coping with learning and tools

Although laws and institutional discourses have established consistency in providing a referential legal framework that increases the opportunities of blind students, the implementation of such laws and discourses is itself discontinuous. For instance, the role of the Institute for the Blind and Partially Sighted is to provide important support for students entering into tertiary education, but at the same time they follow a policy that is cautious about encouraging students to enrol in certain disciplines, arguing that some schools are not prepared to receive blind students and their enrolment will thus expose the students to a hostile environment, increasing their difficulties. Instead of discouraging the students, this kind of institution should be proactive and urge the universities to be prepared to receive students with disabilities and provide them with special tools. In this sense, we could say that the institute concerned is mainly oriented towards the adaptive perspective, providing adaptive technologies. Students in UNA have been met with similar responses from the counselling office. This discourse was evident in both the direction of the School of Informatics at UNA and the Department of Computer Science at AAU, indicating that they were not prepared to receiving blind students. And even though they shared the concern, they did not have the necessary resources to prepare their staff for teaching a blind student in the career programme in question.

In this respect, universities and offices for inclusion should reconsider their actions to ensure a greater degree of inclusion. Wenger clearly emphasises educational environments' need for a good balance between reification and participation, provoking the negotiation of meaning through artefacts and people (Wenger, 1998). For instance, the Institute for the Blind and Partially Sighted has based their support on providing artefacts, working as boundary objects that may well be useful and convenient for the students, but certainly are not enough. This is so, because such artefacts are oriented to support the needs of blind students and do not take into account the necessity of the boundary object to travel across communities, meaning that the use of these tools requires local knowledge and interpretation, making it difficult to influence other practices (Hildreth & Kimble, 2002).

As Burgstahler and Rose and others remark it is necessary to reduce the discontinuities that some boundary objects induce due to their locality. This does not facilitate the incorporation of the students into the general flow; therefore, it is necessary to provide artefacts that make it possible for blind students to perform in the same way as their sighted peers (Burgstahler, 2008-a, 2008-b; Rose et al., 2008). Indeed, Marcus, Julio, Patricia and Ernesto dreamed about a kind of blackboard that can reproduce what the teacher is writing in a format that is accessible to them, enabling them to review such information or even store it for later use (see table 8.2 and [208B]). This is a good example of boundary objects that travel across practices, allowing the teachers and the students, sighted or blind, to work with a standard communication media. However, this tool is not yet available (perhaps it can be develop from Smart Boards), and most of the available tools are just adaptive tools that belong exclusively to the blind student and cannot easily be interpreted for the rest of the community.

This takes our discussion back to Wenger's proposition of a negotiation of meanings through artefacts and people, because what is missing in these solutions is without a doubt people and the tools that fulfil the transportability of them through communities.

In fact, Marcus did not complain about the artefacts he had at his disposal [627B], even though he recognised the extra effort that was required to access much of the material [26B, 200B]. He did complain to some of his teachers [86B, 105B, 186B, 188B]. These complaints came from the teachers, who refused to provide the material in digital format [24B, 643B, 1096B, 1900B, 1961B], even though some of the material had initially been downloaded from the Internet, and who used graphics a lot to teach their subjects, providing no alternative tools [628B, 630B, 1046B]. Here it is useful to recall what Hatwell, Stredi and Gentaz (2003) said on the extra effort that people who had lost their sight early in life had to make to interpret and understand graphics, that was commented in chapter 3.

Moreover, the artefacts that students reported using were tools that supported them, were used by them and understood only by them. We can recall what Julio said in connection with beginning his studies at university. He started recording his classes, but these tape recordings were very difficult to use and almost made him quit his studies [67Y, 75Y]. Then Julio started using a computer with a screen reader and that made all the difference in terms of accessibility, not only easing the process of taking notes in class, but also giving him access to the Internet, digital books and many digital materials available in accessible formats online. In fact, next to the cane, the screen reader has been the tool that gives blind people the most advantages for inclusion [1028B]. However, as described in section 8.1.4.2 the use of screen readers requires that students develop extra abilities to increase their reading speed to compensate for the overhead, organising the reading and accessing the information they are trying to find [728B, 731B].

Another important 'tool' for blind students presented in the two previous chapters is their peers: a vehicle for obtain inaccessible information provided in class. Both Marcus and Julio recognised the importance of their peers, especially in class [645B, 648B]. Also, I noticed during my observation in Julio's class the continuous interaction of Julio and Vicente with some of the other students in the class. Marcus mentioned the chat for exchanging comments with his peers during class as a useful tool [448B]. Additionally, the students in the future workshop in Costa Rica recommended paying students to help them perform specific tasks (see table 8.1), and the teachers proposed cooperation with peers and teaching assistants as a possible solution (see table 9.5). However, both cases revealed tensions, because:

- Even though the students demanded collaboration hours, in the 'dreaming' session in the future workshop and in my interview with Marcus they also expressed a wish 'to not depend on others' (see table 8.2) [153B, 897B].

- When the teachers proposed collaboration hours, Adolfo clearly distinguished between institutional collaboration and collaboration in the form of good relations with peers. He insisted that the first form of collaboration should be avoided, as it would emphasise these students' disabilities as the thing that made them stand out, while assistance from peers would or should be natural. Adolfo's position was consistent with Marcus' vision; he was grateful for his friends' assistance, but he knew that he had to be self-sufficient most of the time.

Therefore, there is a line that connects the tools as elements for coping with the learning process and how the institutionalisation of tools can deflect the effectiveness of the learning environment. Laws and discourses require special attention, because if educational environments choose to follow discourses literally, this might let the inclusion in the tools provided by the authorised offices and blind students' use hereof, denying the need for the proper design for inclusion.

We have discussed the role of tools and the importance of their ability to travel across different communities and to be understood by global practice. In addition, much evidence indicates that tools depend on the active participation of the educational environment to be effective. As discussed in chapter 3, the design for inclusion should not be seen as an act of designing for blind students, but as design for the benefit of all students (Burgstahler, 2008-b; Rose et al., 2008; Scott et al., 2003; Seale, 2004).

However, according to the experiences of the students and extrapolating from the workshops with teachers who had no previous experiences with blind students, both educational contexts need to improve their alignment with laws and discourses as well as their contribution to students' process of coping in educational settings. In section 8.3 it was mentioned that even though blind students in Denmark can contact a supportive office that offers a book conversion service [31B], it is not enough to ensure that the students can access the required material at the required time. This is a good example of the improvements that are necessary to achieve inclusion, especially when the books are part of the course curriculum; in this case the teachers should contact the office to arrange the conversion as soon as they introduce the books in the curriculum. The same situation applies in Costa Rica, where teachers should request the conversion directly and locally in the ODA. This would ensure that the students could access the required books from the beginning of the course. Marcus had an explicit request, discussed in section 8.1.1. He recognised the difficulties in converting books as well as any other printed material that teachers use in class and recommended, as a tool that travels across practices, that the teachers reserved a place on the intranet where they could upload all material in accessible formats and where all students, sighted or blind, could subsequently access them before class [26B].

There will always be areas that blind students need to cope with, because even though we can ease their access to printed material and lectures in advance, their conditions are not the same as other students':

> Because I think my requirements are bigger, I think it takes ... I know it takes more resources to sit at the school for the whole day, listening to the teachers, taking notes and making a summary of your notes, its take more resources from you than it does from the others, because they are able to start looking around, it is difficult to explain … they have the eyes to see with and I must get the same information that they get in other ways and process it in other ways. [200B]

Any other matter or tool used in academia based on graphics would entail accessibility problems, which would require considerable work, providing an alternative solution. This is the case with UML diagrams [109B] and probably also the neural networks course [627B, 1046B]. But institutions should also make an effort to ensure accessibility in their systems [175Y], not only as a goal for achieving inclusion, but also because it is mandatory by law, at least in Costa Rica ("Ley 7600", 1996; "Reglamento Ley 7600", 1998). Under this umbrella universities similarly need to incorporate the theme of inclusion in all curricula, as legislation demands that institutions and companies incorporate inclusion; and if the professionals do not know how to go about it [168B, 174B], a qualitative improvement of our societies would be difficult.

In fact, the simple act of introducing inclusion in university curricula as something that professionals need to consider in their future practices would be an improvement in the inclusion of students with special needs, provoking active negotiation of the meaning of the practices of blind students. This is one way to ease sighted peers' understanding of the meaning of inclusion. Consequently, it would ease the negotiability of practices in universities, established practices and blind students' practices. This will also increase the effectiveness of the artefacts introduced, as it encourages negotiation between teachers and students, sighted and blind, to achieve better participation and reification (Wenger, 1998).

This is important, and with constant improvements and innovation in technology each day blind people have more adaptive tools at their disposal. From table 8.2 we were able to observe students' claim for self-sufficiency. All their dreams were oriented to adaptive tools that would support their independence, and not one dream focused on ways of easing their integration with sighted people. This highlights the relevance of adaptive tools for blind people; with these tools blind people would not depend on others' negotiation of meanings and practices, because they would be able to do all the things that sighted people can do. In addition, I detected an implicit resignation with regard to involving and incorporating sighted people in their solutions, probably because they are used to submitting to the conditions of the majority.

10.1.2. Identities

Identity in connection with these perspectives is a relevant topic, as it directs us towards important issues that may influence the process of inclusion. Here it might be useful to recall what I observed in section 8.1.1, when I started my interview with Marcus. After talking about Marcus and his story for a few minutes, he soon changed the subject and began to talk about computer issues [60B, 63B, 78B, 105B]. His active interest in technology and in belonging to the technological community was evident. As soon as he realised that I was a professional in computer sciences, he was really interested in sharing his achievements and doubts and looked for validation [534B]. This ‘technical’ identity was supported by his student identity, which in many ways tended to locate himself at a level above his peers in what I have called a smart guy identity; as he said, he shared this identity with just two or three other students in class [121B, 124B, 194B, 200B, 549B].

Another one of Marcus’ identities was his identity as a blind person. This identity could be misunderstood as representing his disability, when it should instead be understood as a negotiation of his participation in the context, his conceptualisation of the world, his abilities and limitations and his recognition and acceptance of the discontinuities in the context of inclusion. In fact, this identity was strongly negotiated by Marcus. We can recall his intervention, when he felt relieved after returning from the Institute for the Blind and Partially Sighted to the programming school, ‘to get back on this world’ [17B]. His search for absolute independence is also relevant here:

> I’ve heard so many, “Why do you insist that we do not help you?” Because the worst thing that can ever happen to me is that I have to call some of you guys and say, “Hey, my Windows is actually broken down. Can you help me?” [899B]

These three identities are in constant tension. As his condition is clearly associated with the blind identity, he is really interested in keeping himself separated from the flow of blindness, avoiding stigmas and segregation on account of his condition. This does not mean that he denies or ignores his condition; on the contrary, he is completely clear about his identity as a blind person, he has negotiated his condition many times, trying to belong to different groups, even though some of them have been determined by a peripheral trajectory (Wenger, 1998). Marcus believes that his condition imposes some limitations, but he also believes that most of them can be overcome. For instance, the fact that he is blind made him plan ahead and thus prepare himself for studying programming by learning English at an early age, and attending the International Business College and taking programming courses when possible [17B].

On the other hand, Marcus' technical identity is his prevalent identity, as he has made technology his personal motivation. He was constantly researching operating systems and their advantages, how to make them accessible after installation, finding better tools for developing software [63B, 282B, 288B, 606B, 890B] and experiencing new software, almost like a collector.

His smart guy identity helps protect him against the areas where accessibility issues prevent him from full participation. In these cases he has to make a bigger effort, with outstanding results, to compensate for things he cannot do or things he cannot do as well as required, like developing GUI or understanding neural networks [26B, 121B, 200B, 627B].

Nevertheless, he was emphatic when he explained to his friends that he is not that much cleverer than his classmates, but because he cannot play basketball, for example, he uses this time with computers, learning, and that enables him to develop better skills and acquire more knowledge [549B]. This is another example of Marcus' personal negotiation between his three identities: his blindness, his own view of himself as cleverer than his classmates and his dedication of his time to academic and technical matters.

In contrast, when I met Julio he was still negotiating his blind identity, as he had lost his sight relatively recently. We should recall that Julio lost his sight at the age of 19, and since then he had needed to negotiate his identity through his experiences as a blind person. He had to face his feelings, overcome his feeling of embarrassment and his fears that people would make fun of him [58Y], and he had to stop 'blaming God' and look for 'interior peace' [90Y].

In this process, unlike Marcus Julio was inclined to share his experiences with other blind students at the university to learn how they solved their problems [90Y]. Even though they were attending different career programmes, he had a closer relationship with them than with his classmates. He was happy to go to the Hellen Keller Institute, where he learned how to cope with his blindness and was inspired by other blind people who attended the institute. This is where Marcus and Julio really differ. Marcus has had a long time to negotiate his practice and to reify his blindness and learn how to do things. In contrast, Julio needed to learn how 'to be blind' and to do all these things in a very short period of time. As Marcus was born blind, his process of reification was to understand how sighted people see the world; he had to imagine colours, mountains, the horizon. Julio, on the other hand, needed to understand how he would cope without his sight. He had a tendency to show his difficulties as a road to self-acceptance. In addition, he frequently referred to himself and other blind people as 'we', confirming that he belonged to a group of blind people; this constituted a way to participate in a new practice and, therefore, construct his new blind identity. Moreover, in this process there was an implicit assumption of a kind of 'blind discourse'. For instance, Julio commented:

> We, as blind, never include an image; our work is in black and white and nothing else. We do not include any colour, we ignore this option [228Y].

It is interesting why he refuses to use colours or images, because he had both in his mind, in his memory. This was probably part of his process of belonging to the blind community; he needed to link his learning process to this community in order to adapt to his new condition. In one way or another, Julio was in the process of constructing his blind identity, whereas Marcus did not meet with other blind people to avoid being associated with the 'blind group' and be segregated.

Another difference between Julio and Marcus was the former's limited commitment to Julio's choice of career programme. Recall from section 8.1.2 his explanation for his decision to study counselling: it fitted better with his condition, as this subject is 'more theoretical oriented' and "it is lighter, more accessible and … you do not have too much mathematics' [180Y]. However, Julio was confident about doing a good job, even though he was aware of the limits imposed on him by his condition [269Y]. Hence, Julio's blind identity, still under construction, was stronger than his student identity, whereas Marcus' technical identity dominated his blind identity.

In fact, in section 8.4.1 I commented on students' participation in the academic flow. Marcus argued that his opportunities were no different from his classmates, as long as he had the screen reader [1028B]. However, at times some tension surfaced, for instance, when Marcus agreed to do his assignments separately, as his peers had to develop a user interface and he would do the programming part; this is an example of his peripheral participation. Nevertheless, Marcus' participation in all his years at university had provided him with enough experience to allow him, together with a solid reification of his blindness, to construct his student identity, because, as Wenger has said, identity 'is a layering of events of participation and reification by which our experience and its social interpretation inform each other' (Wenger, 1998, p.151).

On the other hand, Julio commented on his notion of what people in general thought about blind people:

> […] it is in these moments that you experience what people think in regards of people with disability, even if they [people with disabilities] are studying. Often, people do not see them projected in real life; they cannot see how a blind person can progress as any other person would. This gives me strength; it encourages me a lot, because I would like to demonstrate that a person with disability is a person just like any other one, with projects, with motivation to study, a person with feelings and emotions. [283Y]

It is clear that he was still negotiating his disability, looking for acceptance from other people and using education as a way to prove that his blindness does not reduce his opportunities. In other words, Julio was still negotiating his participation in the context as a blind person, and his process of reification was still a matter of tension. One of the happiest days of his life was described in section 8.4.1, when he had to do his first assignment alone and he realised that until that moment his participation in his learning process had been marginal, performing mere simple tasks. What made this a happy experience was when he was finally able to accomplish this assignment [297Y]. His happiness was the result of his reflection that, despite the many obstacles he had had to face, he was able to participate fully in his educational process. One might argue that it was in this moment that Julio’s student identity got stronger. In fact, when I interviewed him, he was more committed to his career programme and showed more confidence than before.

On the basis of these observations I might argue that a solid blind identity is necessary for creating the conditions for a proper negotiation of identities, practices and participation. But also, as discussed in chapter 3, it is essential that students understand how they learn and how they can focus on what they can do instead of what they cannot do (Webster & Roe, 1998)

Therefore, Julio and Marcus entered into tertiary education with different blind identities. To succeed in this context they needed to trace their ‘inbound trajectories’ (Wenger, 1998, p.154) and negotiate their blind identities to ensure their own full participation in their new practices as students, reducing the impact of peripheral and marginal participation due to the educational context’s lack of preparation in inclusion matters. In fact, the better prepared the environment is for ensuring inclusion, the easier it will be to integrate ‘boundary trajectories’ (1998, p.154), facilitating the convergence of student identities and blind person identities.

From the interviews it is possible to confirm the boys’ high degree of belonging to their respective educational environments, particularly when talking about engagement and alignment, because both of them approached their educational environments as they were: designed for sighted people. Both students made an effort to fit in, experiencing the discontinuities observed in chapters 8 and 9. Indeed, they recognise these discontinuities in the interviews, but neither of them insisted on pushing their story into the established practice, in some sense they were passive actors in the process of introducing inclusion in their contexts. Like most newcomers, they decided to sacrifice their own identities to achieve continuity in the construction of their student identities (Wenger, 1998).

The negative impact hereof is not as obvious as the consequences in the learning processes, but there are consequences, as this attitude is a response to the dominant group. The students, in one way or another, were submitted to the power of the dominant group (Clements & Spinks, 2006) [17B], limiting the necessary negotiation between their practices as blind persons and the established practice.

I believe that the lack of negotiation in both cases resulted in very weak belonging by imagination. As opposed to the engagement and alignment, the imagination is an important component in seeing oneself in future activities, here as professionals with their own practices. This means that belonging by imagination evokes the opportunities that the educational environment is teaching for their future practice. In the previous cases of belonging, as they were related in the years the students spent at university, the students were able to resign to inclusion practices and make an extra effort to overcome the limitations imposed by the educational environment, but when they had to see themselves in the labour market, they had to get ready to face it in all its extensions.

It is in this vertex that the discontinuities in the educational environment play a considerable role. In sections 8.4.2 and 8.4.3 I presented a summary of the problems connected with participating in the educational environment and in preparing for the future. The students were clear about this situation, for instance Marcus wanted to validate whether he would be able to develop accessible software when he found a job as a programmer [176B]. As mentioned above, he was not prepared for it, as he had never received any instruction and had never been part of a workplace. But his main problem was to trust that he would be able to get a job [1092B, 1364B]. Every student is likely to worry about being able to find a suitable job, but Marcus' fears were more concerned with the characteristics of the job he would need. He knew that graphical interfaces were in demand in the labour market, and this was something he could not do. Julio and Vicente attended courses to acquire techniques that were new to them, as described in section 8.1.4.4. Therefore, they needed to imagine that they could change these techniques for the benefit of others, including 'forums from music or narratives, dramas, group discussion'

[240Y]. The question is why the other students simply had to learn how to use techniques that had already been designed, whereas blind students had to design their own techniques? Does this mean that the latter will be losing an important part in their training as counsellors, or should they be able to design their own tools as part of this training?

The deficiency of the educational environment is that it does not inform blind students of the alternative options they might have in the labour market. Universities could at least inform the students of these opportunities, help them reflect on their professional options or preferences and what they have to do to be successful in their area, or cooperate with them in exploring new possibilities. In other words, universities should, as Wenger has said, guide students in their new professional identities, ‘as an expanding image of the world’, ‘as self-consciousness’ and ‘as a creation’ (Wenger, 1998, p.272, 273).

Then the following questions arise: How are blind students identities constructed? Are they constructed like any other identity, or should we talk of a special blind student identity? The answer to these questions is given by the level of inclusion achieved by the educational environment. Provided that the established practice includes concepts of universal design, as described in chapter 3, and it has provoked negotiability and identification, not only in blind students, that have been doing it since they have their condition, but also in teachers and sighted students, who are likely to have very limited or no contact at all with blindness, the identity of a blind student could be that of any other student. In other cases, blind students have to struggle to develop their own blind student identities.

10.1.3. A practice of inclusion

The first step in talking about a practice of inclusion from the perspective of inclusion described in chapter 3 is to make it the aim of educational environments.

In this context I want to recall some of Wenger’s definitions of practice:

> Practice is a process by which we can experience the world and our engagement with it as meaningful. (1998, p.51)
>
> Learning is a source of social structure. Practice is produced by its members through the negotiation of meaning. (1998, p.96)

10.1.3.1. Moving towards a practice of inclusion

From these definitions it is important to highlight that an inclusive educational environment cannot emerge spontaneously from the established practice, as such environments have being established by the current members, teachers and students who are likely to have had no contact with blindness, and who have negotiated the meaning of the environment on the basis of their own experiences. Also, this practice has been established as a way to experience the world through a context that makes sense to the members, and blindness does not make sense to sighted people who have no previous experience with it. To illustrate this, Julia talked about preparing herself for inclusion:

> And who has this resource? And not only the resource, because I could be full of good intentions, but if I do not know how to do it better for a blind student, it does not matter the resources and the good intentions, at the end, I still will do something that the student will not understand. [64G]

This comment was discussed in section 9.2.1 in connection with the participation of teachers with no previous experience with blind students in the first workshop (we should recall that some of them had experience with students with other special needs and that this did not necessarily mean that they had a better understanding of blindness). Thus, their reactions were based on their preconceived ideas about blindness (see tables 9.3 and 9.4).

On the basis of the work they did to identify students' difficulties [25G, 26G, 35G, 44G, 60G, 62G, 64G, 67G, 77G, 83G] (see also tables 9.3 and 9.5) I observed that the same teachers did not consider several of these difficulties important when they interacted with the students in the second workshop. Later, more difficulties were discredited explicitly by the same blind students, reviewing the tables made by the teachers.

In section 8.2.5 we discussed that Marcus, in agreement with the results from the workshops, did not find that teachers were very interested in blindness; he stated that they did not understand inclusion and, in many cases, they did not understand blindness either [2095B]. We also discussed Julio’s and Vicente’s feelings after a class where an invited teacher had started her presentation by talking about inclusion, but only presented the instruments concerned in a visual manner, causing the students to feel completely excluded [218Y]. Even more so, they expressed that the message they received from this teacher was that to be a good counsellor they had to use the instruments in question, and as they were unable to do so, they would not make good counsellors. Thus, the students adjusted their learning processes to established practice, but the educational environment did not in the same way negotiate blind practice, resulting in a practice of non-participation or marginal participation as described in section 6.2.

The best example of this marginality was described in section 8.4.1 and discussed in connection with identity formation, when Julio was talking about the happiest day he had had in academia. He was happy, not because he could submit a successful project, but because he could submit the project regardless of the marginal participation he had experienced. After having attended university for some semesters he discovered that his participation in his own learning process was marginal, doing what his peers believed he was able to do, without the effective supervision of his teachers to ensure his full participation in workgroups and assess his learning process [297Y].

At that moment Julio was negotiating his history with his new condition, learning his practice as a blind person and as a newcomer in the established practice. Therefore, it was difficult for him to construct his blind identity and his student identity, especially because the educational environment at large utilised non-accessible tools and artefacts, discourses and a practice that did not support blindness, consequently emphasising the marginality of students with this condition (Wenger, 1998). This generated discontinuity in the negotiation of practices and it compelled Julio to adapt to what he considered the established practice, a practice that he had to follow, a practice that made Julio's participation in his own learning process marginal. It was not until he had to face a learning activity on his own that he realised he was losing a fundamental part of his learning process.

This event clarified some things for him and it probably triggered important negotiations of meaning, empowering his blind identity. But even if the students have a strong blind identity, the phenomenon described above still produces discontinuities in both practices. For example, Marcus decided to reject participating in full in assignments involving graphical interfaces, without fully understanding the implications hereof. In section 8.4.3 I described the situation where Marcus declined developing graphical interfaces [446B], but he still believed he would be able to work, as he had learned to communicate with others [868B]. His conclusion was correct and he proved it when he found a job after graduation, but this was not a decision made on a solid basis, supported by experts in the field. In other circumstances, such a decision could have led to frustration and injustices, if it had affected his opportunities for finding a job.

With these examples we may conclude that the learning environment for blind students contains discontinuities, limiting their participation and potentially reducing their future opportunities in the labour market.

Regardless of these discontinuities, the students continued consolidating their student identities and they hoped that they were offered a job that allowed them to do what they like the most: counselling adults or adolescents [247Y, 249Y, 269Y] and writing computer programmes [165B, 1094B].

10.1.3.2. Modifying practice

Other situations are to a greater extent related to the convergence of blind practice and established practice. This convergence is described by many authors as Universal Design (UD), explained in chapter 5, as the design of learning architectures for the majority and their needs, instead of reacting to the individual students' needs (Burgstahler, 2001, 2006, 2008a, 2008b; Rose et al., 2008; Scott et al., 2003; Seale, 2004).

Thus, when Marcus said that all he needed in order to complete his study programme was his screen reader, he was approaching the educational context from the adaptive perspective, described in chapter 3, focusing on the tools he would need to adapt. In the interviews and observations I could find no suggestion of an explicit design for inclusion. Conversely, they showed me many examples of how inclusion concepts were missing. One of the more basic adjustments on the part of the teachers was to provide in advance and in accessible formats the material they planned to use in class as well as any extra material. Marcus underlined that this would be useful both for sighted and blind students [24B,140Y, 643B], fulfilling the UD principle that solutions should be the same for all students (Scott et al., 2003; Seale, 2004). Many of the teachers failed to do this simple task, though, even though the students had asked them repeatedly.

Another area in which it would be easy for the teachers to respond to UD was to use textbooks that were available in digital format. This is not only a good solution for blind students; it can ease the workload of many students with special needs and help students in general. However, it is still necessary to confirm that a given book is accessible, even if it is in digital format. If so, this would, as Marcus said, constitute an excellent help in fulfilling his needs [1084B, 1096B].

Another non-inclusive area was the treatment of graphical or inaccessible material. Marcus complained about courses like artificial intelligence, which was based on graphics, and assembler, where he questioned the teacher's abilities. What was characteristic of both courses was that they were not easy for Marcus to access, and that might have made him biased towards his teachers [86B, 672B, 1046B, 1049B]. Another course with special focus on graphics was system engineering, which required the use of UML diagrams, but in this case Marcus waived the use of the graphs with the teacher's consent [869B, 871B, 2134B, 1900B, 1961B]. In Julio's case, we have already discussed the conference that was meant to present material for counselling students. However, all the material was totally inaccessible (see particularly section 8.2.2) to the counselling students and their future students if they were blind [618Y, 626Y].

Now, the problem with material with limited or no accessibility is more complex to solve. Firstly, as discussed in chapter 3, it is difficult for blind people to interpret drawings and graphs, especially for those who were born blind, generating negative reactions when they are forced to work with graphical representations (Hatwell et al., 2003). This statement was backed several times in my interview with Marcus [44B, 109B, 111B, 119B, 122B, 124B, 197B, 1046B, 1050B, 1098B]. Also Hatwell et al. states that the extra effort students have to put into interpreting and understanding graphs and drawings can be beneficial from a pedagogical point of view, due to the intense cognitive work required (2003). This statement is also backed by Marcus:

> I know that blind people are unable to draw very well neither are very good in mathematical drawings, but seeing something graphical can help you, believe it or not, it can actually help you if you see for example a coordinate system with a straight line. That is actually very helpful even though you may not be able to understand it, but if you see it you can say, "Ah, okay, that's what it looks like, that's what they want me to do". [1098B]

In this case, it is desirable that drawings are accompanied with tactile and auditory support. UD is required in order to promote the convergence of practices into a single inclusive practice. This requires some knowledge of blindness and the tools available and an office that can help teachers design such alternative tools. For instance, when Marcus recognised the relevance of a tactile representation of a coordinate system, [1098B] he did not know about the existence of a simple technique for producing these kinds of graphs with an embosser, and he did not know whether it was used in the educational environment. In the Universidad Nacional the ODA provides embossed graphs and drawings as well as printouts in Braille. They can also assist teachers who are interested in producing materials in these formats. There are limits to this service, for instance, preparing mathematical expressions or formulas in order to ensure the appropriated unfolding, when the students use them with a screen reader (discussed in chapter 4).

So far the proposal for a more accessible educational environment has been based on the adaptive perspective and concerned unexpected situations. That is, I have neither considered intentionality nor design for inclusion. In section 8.2.2 I mentioned how Marcus' system engineering teacher allowed him to skip UML diagrams [1961B], but later Marcus lost points in the exam because he did not use the diagrams [1900B], showing an inconsistency in the teacher's response, probably because the latter was not a product of a designed curriculum.

This was expected to have been a result of limited understanding and interest in inclusion. Inclusion was absent in the curricula design and in the teacher's attitude and it was absent as a concept in itself. Inclusion was barely mentioned in Julio's context [269Y] and never in Marcus' [1024B]. This means that the time and space for negotiating their identities were not provided, forcing blind students to rely on themselves to build their student identities, taking established practice as their starting points and ignoring any negotiation of practices. This situation submitted their practice to established practice, reducing students' participation and limiting their identity negotiation to improve the engagement and alignment. In addition, this resulted in reduced opportunities for improving their mutual understanding of the different roles they can adopt as students and in their subsequent professional lives. Some of the consequences hereof have been discussed in connection with my interview with Marcus, who recognised that his peers and teachers failed to better understand blindness, using himself as an example; it could have eased the incorporation of concepts of inclusion into the curricula [1042B] to teach students how to develop accessible software. And this would without a doubt have improved the learning environment for Marcus.

The most obvious consequence in both cases was the lack of educational imagination; this was completely absent in their educational environments. Marcus was aware that he ignored parts of his career programme, and it made him anxious about finding a job, because he had strong doubts of his opportunities in the labour market and how he should deal with people [1373B].

Julio, on the other hand, reflected on his future working skills and built his own alternative tools with no validation from his teacher. That is, rather than design finished tools he proposed ways to build these alternative instruments. He commented that he would use ‘forums from music or narratives, story narratives, dramas, group discussions’ [240Y]. Nevertheless, he had neither figured out how one was to work with these tools nor had he tested them. In fact, when we started to reflect on these solutions, Julio had not considered the implications of their use by students who were visually oriented or too shy. He was shocked when such a situation occurred. A similar situation occurred when his teachers presented tools in class, arguing that these kinds of tools would be easier to use and might work for most students; however, blind counsellors would not be able to use visually oriented tools, even if their students preferred these tools.

Therefore, both educational environments were far from achieving an acceptable level of inclusion, since neither of them provided spaces for the students, sighted and blind, to share activities, responsibilities or challenges connected to different practices in order to thus generate a sense of commitment between them. The environments did not offer orientation, reflection or exploration for providing alternatives for the students’ future lives and current identity formation. Finally, they neither supported a cross-boundary negotiation of practices, nor legitimised multi-membership. Conversely, these educational environments led blind students to renounce to their blind identities, making their blindness invisible when they ignored the basic concepts of inclusion.

10.2. Identifying levels of inclusion in educational environments

Via this research we have learned about the undeniable interweaving of social structures, tools, ways of coping with learning, adequate inclusion practices and the solid formation of identities – with the objective of generating a feasible inclusive educational environment. This has being counterpoised by the mistakes committed by the educational environment, pointing to unsolved difficulties, deficiencies in the learning process, the subjugation of identities and practices under the majority power of the sighted and the students' choice to stay in a comfort zone where they try to adapt to the educational environments rather than work towards a universal design, as coined by Ronald Mace (Scott et al., 2003).

However, it is important to note that an inclusive educational environment is a process. Therefore, we should now have some guidelines for measuring the level of inclusion in a particular educational environment. I argue that an educational institution can work with three levels of preparation for inclusion. This is not governed by discourses or policies; it is determined by the degree of reflection, analysis, understanding and design that schools perform in order to ensure an effective process of inclusion.

The other part of this process is determined by the blind students and relies on a strong blind identity. These students' technical identities allow them to build a consolidated student identity that is similar to the ones of their sighted peers. If any of these identities are weak, it will limit the students' performances in the educational environment, their chances in the labour market, and they are likely to develop professional skills that are limited by people who do not know what it means to be blind or to be a technician in the given discipline.

10.2.1. The entry level

The first level of inclusion in educational environments is based on individual initiatives, often improvised and poorly managed, and it may even include some sort of ‘assistance’ or ‘consultancy’ by specialised offices; in the end, though, it depends on the goodwill of the teachers. Consistency and availability depend on the teachers’ good intentions. However, it could be worse: if the teachers do not have a predisposition to support, but to solve ‘the problem that he or she has in class, just letting the student pass the course’. Another situation could be a lack of interest in supporting the newcomers. In any case it suggests that the result is an inarticulate or absent design of the inclusive environment, providing unreflective solutions to inaccessible topics and pedagogical adaptations that are not designed to support the required learning. Notice that situations like these can occur even if schools have drawn up inclusion discourses or policies; perhaps they also include special tools and certain forms of support.

The consequence hereof is that students risk missing topics that are crucial for their academic futures or working abilities. This is so because they focus on surviving in a hostile environment and thus need to put great effort into accomplishing this task. These students’ chances of approaching inclusion are thereby lost.

10.2.2. The next level, getting into inclusion

The second level depends on the active participation of the academic and administrative staff, preparing an articulate environment, thinking about the students’ needs in connection with completing their career programmes, providing tools and support that give the students as much information and as many skills as possible. They should provide the material the students need to pass their courses without making a significant extra effort. On this level, revision of the contents of the courses is needed to ensure that key topics are covered in an inclusive manner. Also, this requires an engagement of teachers and administrative staff as well as the participation of decision-makers to provide better support for the students in question.

It is possible that this level is the most common level for schools that consider themselves inclusive schools, and it is unfair to consider this level inadequate, because in order to achieve the above schools depend on the effort of many actors and it does give the students great opportunities for achieving their study goals.

10.2.3. The desirable level of inclusion

This takes us to the third level, that is, the one that cultivates the inclusion process, translating it into practice. It is the process that cultivates the belonging and negotiation of identities. It is not a process that affects blind students only; it affects the entire community. It is a process that negotiates local and global meanings. On this level the school not only ensures accessibility to information and the required skills in teachers, it also generated an environment where teachers, students and administrative staff get engaged in a single enterprise, regardless of their individual abilities or difficulties, enriching their practice via the negotiation of new practices and new identities.

Therefore, the main difference between levels two and three is the negotiation of identities and belonging, pursued through the participation or non-participation of the blind students. The relevance of this difference is as important as the principle that learning and identity are intrinsically tied together; one shapes the other and vice versa (Wenger, 1998). Via the successful negotiation of meanings it is possible to reshape the identities of all participants – blind students, teachers, sighted students and administrative staff – shaping everyone's trajectories in order to achieve new communities with aligned identities. 'It is about balancing the production of reificative material with the design of forms of participation that provide entry into practice and let the practice itself be its own curriculum' (Wenger, 1998, p.265). Therefore, this concept is interesting and suggests ways of introducing into the same curriculum different inclusion-based practices as a way to endow the curriculum with inclusive concepts that stem from the practices of blind people.

As mentioned above, imagination is fundamental when we are talking about any post-secondary educational environment, because a curriculum is nothing but referential contents that the students need in their future professional lives. But more importantly, the students can constitute a solid image of the possible trajectories available in the specific area of study. Here we can draw on Wenger:

> Students must be enabled to explore who they are, who they are not, who they could be. They must be able to understand where they come from and where they can go. (Wenger, 1998, p.272)

This is particularly important when a university is expected to reach the third level of inclusion. On this level it is not possible to think about preparing future professionals without at the same time giving them a clear picture of their abilities and strengths as well as their limitations and weaknesses, without a clear introspection of their identities or the abilities to explore new ways of doing their jobs. Losing the opportunity to shape the students' identities could limit their professional futures in the educational environments. Therefore, it is imperative to foster identities that will expand the scope of the students.

This 'expansion' is also stimulated by continuous cross-boundary exercises. Educational settings need to provide enough opportunities for students to practice crossing boundaries and thus enrich their knowledge of ways of succeeding in the world (Wenger, 1998). This is precisely what the third level of inclusion is about, and the boundaries they have to cross are the ones between their computer science student identities and their blind student identities. This multi-membership should prevail in professional practice, but this is not accidental; it is based on the students' experiences in their career programmes and their active negotiation with their peers and teachers, training to face this membership in the outside world.

10.2.4. The relation to the perspectives

Considering the perspectives described in chapter 3 – the medical perspective, the adaptive perspective, the integrative perspective and the inclusive perspective – we can compare the last three with the three levels described above. The medical perspective is outside the scope of this classification, as educational environments will not and cannot address the needs of their students from this perspective. This does not mean that the educational environments do not have many manifestations from this perspective, as they can exist at any level; what it means is that the educational environments act in response to a specific perspective. The medical perspective focuses on solving the blind students' 'sickness' and correcting their shortcomings, but this is not the objective of educational environments. Also, we should recall that different perspectives could be complementary to achieving other perspectives. In the case of the medical perspective it could be useful to provide measurements or instruments for supporting blindness, but this support is usually oriented towards the students and not towards the environment. It might provide instrumental tools for applying adaptive perspectives. In fact, inclusion discourses based on medical perspectives would reveal if an educational environment was on the first level of inclusion.

Therefore, the first level corresponds to the adaptive perspective, where accommodations are oriented to satisfying the students' specific needs and focus on the way they use existing tools. Institutions at this level would respond to the premise that the students have what they need in order to be in the educational context, and if this is not the case, someone else should provide what is missing, arguing that they do not know how to solve it nor do they have a budget that allows it.

The approach at the second level corresponds more to the integrative perspective, where students are offered an evaluated and adjusted environment that responds to most of the students' needs. The concept of universal design should guide this perspective, as it presupposes that the educational environment is always designed with each individual student's education in mind.

Finally, the third level corresponds to the inclusive perspective where not only the learning environment is prepared for inclusion, but the institution in general adopts a universal design philosophy, covering not only adaptation and design for all students, but also providing the time and the space for participation and reification, for the negotiation of identities and practices. This learning environment provides opportunities for orientation, reflection and exploration through cross-boundary experiences.

10.3. Making the improvements

As mentioned above inclusion is a process, and I am interested in how to advance from level one to level two and then from level two to level three. Our point of departure should be level one, where the educational environment has made no progress in incorporating adaptive tools. In order to move on to level two, the existence of such tools is mandatory. The interesting paradox is that the most relevant adaptive tool, the screen reader, is brought by the students and not provided by the educational environment, at least not directly. We should remember that Marcus said that the only thing he had to be fully competent in was the screen reader [1028B], and Julio said that learning to use the screen reader increased his academic opportunities [75Y]. Consequently, students need to receive a larger quantity of information in a medium that is accessible with this tool [24B, 26B, 67Y, 75Y, 86B, 105B, 186B, 188B, 200B, 628B, 630B, 643B, 1096B, 1046B, 1900B, 1961B]. Without this information their extra work could potentially exceed their capacities, turning the educational environment into a segregated environment. A valuable result of this research is that, according to the students' perception, this situation is more widespread than we would like to know.

Another conclusion from the workshops is that inclusion cannot be developed by the teachers' intuition. We should recall from the first workshop that the teachers produced a list of difficulties they assumed they would have to deal with if a blind student signed up for their class. Some of these difficulties had already been solved (see table 9.1) and others were wrongly addressed. In fact, we can extend the conclusion that has been resonating throughout this thesis: Inclusion requires design, and according to our framework design is:

> [...] a systematic, planned, and reflexive colonization of time and space in the service of an undertaking. This

> perspective includes not only the production of artifacts, but also the design of social process such as organizations and instruction. (Wenger, 1998, p.228)

Therefore, I stated that an educational environment requires design in order to move from level one to level two. In this respect, Claudia went even further:

> The university needs to invest in researching. For instance, if this semester we have five new blind students, we should follow them up, systematising and documenting in order to have possibilities to improve, to evaluate why it worked and why it did not, keeping what worked and eliminating what did not. If we do not register nor systematise it, we are doomed to failure … experimenting under try and error basis, that probably would be very productive at the beginning, but it will hinder the progress later if we do not consider previous experiences. [241G]

To determine the inclusion level of a specific university, the first question one must ask is: How many teachers design for inclusion? If the answer is most of them, the university is likely to be at level two or three. As the students from my case studies were attending level-one educational environments, it is possible that I might have missed considerations that were not evident from the data collected. However, because design is mandatory for moving from level one to level two and design implies reflection, systematisation and planning, and because it is necessary to incorporate artefacts, reorganisation and instruction (Wenger, 1998) and formal research, I might add, these elements comprise the basis for moving from level two to level three.

For instance, I suggest that introducing the concept of inclusion into the curricula to incorporate it in future professional practices could improve the active inclusion of university students with special needs:

- This would require that teachers understand and receive training in the concept of inclusion.

- As the students would need to incorporate the concept of inclusion into their work, it would require a better understanding on the part of the students as well.
- Both actions depend on policies from the university which in turn must provide the resources and facilitate the incorporation of the concept into the curricula, turning any inclusion discourse into concrete action.

This work requires design in the start-up phase and subsequent research to improve the effectiveness hereof. It is important to highlight that merely considering inclusion concepts does not guarantee such improvement. It must be done systematically and include experiences that give meaning to the students, allowing them to appropriate the concept rather than react to existing rules to achieve inclusion in different disciplines. We should recall that Marcus, Julio and Vicente declared that they do not know how to produce software or accessible material for persons with other special needs [173B, 176B, 225Y, 226Y, 235Y, 240Y]. Here, a deep understanding of their own needs and of the concept of inclusion concerning blindness does not help them understand the special needs of others. Therefore, the absence of a systematic inclusion concept in their career programmes did not improve their inclusion abilities concerning other disabilities, notwithstanding their strong compromises.

Moreover, in the first workshop the teachers expressed a concern with having blind students in their classrooms, because they did not know how to work with them. Some of the teachers had previous experience with persons with other special needs, but this only helped them get motivated to participate in the workshops [4G, 6G, 8G, 9G9]. Therefore, the teachers were interested in a systematic introduction to the inclusion of blind students. They had to learn everything from how to communicate with them up to how to give them access to the tools used in the given career programme [10G, 35G, 25G, 26G, 44G, 57G, 60G, 62G, 64G, 67G, 77G, 83G, 114G, 270G]. To complement this learning the workshops included activities where the teachers experienced blindness on their own bodies in order to enhance their understanding of what students need to face in their studies.

These activities revealed the teachers' fears of becoming blind. These feelings illustrated to them how much they depend on their sight [16G, 19G, 20G, 24G, 32G]. After these activities the teachers produced a list of the difficulties, and solutions, they thought blind students might have with the current curricula. Some of these difficulties and solutions were later rejected by the blind students, because they had already been solved or introduced. Others were wrongly classified (see chapter 9). Additionally, as soon as the teachers started to interact with the students, many fears and doubts were invalidated, naturally. Finally, when the blind students read the agenda in Braille and used the screen reader, the teachers turned their attention to social structures and policies [308G, 335G, 678G], understanding that the problems were in other areas; they recognised that the student is not the problem, the problem is in the educational context.

In the last workshop the teachers commented that these students have passed through a 'prolonged filter' in primary and secondary schools: a natural selection of students with determination, interest and academic excellence who would later enter into university [642G, 643G]. They should be capable of completing any given career programme, if their conditions allowed them to pursue that particular career; and other students and the institution should provide the following:

- A proper teacher-student relationship
- Technological support
- Properly designed curriculum, contents and methodological strategies. [656G]

These conclusions are, consequently, aligned with what we have discussed, concerning the educational environments' need to design for inclusion. Depending on the perspective of the design – integrative or inclusive – this improvement will move the environment on to the next level. In this respect, the teachers also concluded that after the workshops they felt confident to start the design of the environment; now they had a better understanding of blindness, and this was a valuable contribution from these workshops [630G, 674G, 678G, 681G, 682G]. Julia considered these workshops the first step towards inclusion:

> I think these activities in this school, I may say, are extraordinary, because we never … this is a good starting line point; we are building “ramps”. We have talked about ramps for those using wheelchairs, but these are the “ramps” that we need in our School and we have not seen before. We need to ease the learning and other things … and this activity has been very useful for me. [276G]

To construct these ramps, teachers can use the principles for UID produced by the Center for Universal Design at North Carolina State University as a guide, listed in section 4.3.4.

10.4. Summary

We have been dealing with learning environments and their inclusive perspective on the basis of the social theory of learning’s (Wenger, 1998) definition of the elements that should compose such learning environments. In this analysis we have been able to explain the continuities and discontinuities in the educational environment, the relevance of the adequate vehicles for exchanging information and providing skills and, of course, disabilities’ influence on blind students’ opportunities for participating in full. Identity is particularly relevant, from the role of identity when students enter into university to the formation of new identities in order to succeed in the career programme in question and in their future work lives. Also relevant from the social theory of learning are the concepts of practice, theories of social structures and situated experience, producing institutional discourses, laws, practices for coping and inclusion.

These concepts interwoven with the concepts of blindness and universal design covered in chapters 2 and 3 and the tools covered in chapter 4 generated a unified concept of the social theory of learning and blindness, a concept that was used successfully to answer the research question: How can the School of Informatics prepare to receive blind students?

Two other major findings are related to the convergence of practices and tools. With regard to practices we have discussed the fundamental role of understanding blindness and the importance of negotiating students’ meanings and practices in order to pursue new meanings and practices for the whole community, converging in a single inclusive practice that provides multiple means of representation, multiple means of expression and multiple means of engagement (Rose et al., 2008). I have suggested that the inclusion concept is incorporated in the curricula in order to teach students to bring these concepts with them into their future work activities, giving them a collateral advantage as these concepts work as facilitators for negotiations of practices with blind students. In any case, at least in Costa Rica, this is mandatory by Law 7706, which pursues equal opportunities for people with disabilities. Still, it is necessary to provide the time and space for sharing experiences, identities and practices among students, teachers and administrative staff.

With regard to tools we have discussed the relevance of offering these to blind students, complementing the preparation work done by the educational environment. Such tools should be designed as cross-boundary objects, not as solutions that blind students can use to adapt to the practices of others.

Also, we have discussed the workshops as a tool for launching the inclusion process. In a few hours it was possible to improve the teachers' understanding of blindness considerably and move them towards becoming potential participants using Universal Design principles in their work as promoters of inclusion in their contexts. They did not resolve all their doubts, but they did overcome their fears, clarifying what needs to be done, even though they still need to get deeper into *how to do it*.

As a tool for supporting the inclusion process three levels were described to identify the state of the art in each educational environment, following a self-evaluation process concerning their own processes of inclusion. These levels can be renamed as:

- The entry level
- Getting into the inclusion level
- The desirable level of inclusion

< CHAPTER ELEVEN >

Final thoughts

> *There is a central unit located in Hellerup, they have study counsellors, study advisers, they do some counselling and advise about some support devices, but they do not assess the situation and the specific technical needs for each person, because each person will need different kind of support depending on their particular situation. But still, these people are very important because you need both things, if you said you are going to study informatics, you will need to take into consideration this, and this and this. [Rosa is a former student at AAU and partially blind]*

In this last chapter I will discuss my final thoughts on the conclusions generated in this thesis, the recommendations that can be deduced from the research and finally present some proposals for further research and development.

11.1. Conclusions

This thesis is useful to different groups with different interests. For instance, it contains enough information to improve the understanding of the reader of what it means to be blind. This is probably the most important goal achieved in this thesis, because it makes it increasingly useful to all readers, promoting their participation in the process of inclusion concerning blind people. Similarly, it is important to have developed a theoretical framework for working with inclusion in educational environments and to have produced, on the basis of the fieldwork, a description of the world of blind students and their difficulties in their educational environments, comprising a starting point for the process of inclusion in higher education institutions that is useful to any academic reader of this work.

11.1.1. Understanding blindness

The proposal for understanding blindness was established ecologically, starting with legal discourses, preconceived perceptions and the influence of society in the construction of such perceptions. Definitions that frame these perceptions were introduced in chapter 2. Two different conceptual classifications were presented:

1. The role of social structures, contributing to the construction of blindness as institutionalised discourses, sometimes supporting legislative changes, sometimes submitting discourses to the legislation. In both cases these structures have influenced people's perceptions and have consequently affected the world of blind people. When discourses have promoted structural changes to improve blind people's conditions, they have provided support of more inclusive societies. On the other hand, when the discourses presented are excused from ambiguous interpretations or outdated laws, the opportunities of blind people have been withdrawn.
2. The social construction of disabilities includes prejudices and misconceptions about blindness, constituting the way that people react or behave, collectively or individually, towards blind people, encouraging or hindering their inclusion processes. Thus, the charity model, the medical model, the rights-based model and the economic model establish a frame for meeting this objective, and even though there are other possible classifications, this is sufficient to distinguish clearly the standard perceptions, reactions and behaviour of people in different situations. Here it is important to note that people can belong to different categories

> in different situations. Also, this classification helps identify situations that require improvement with regard to inclusion. In conclusion, the relevance of this classification lies in providing an identification of people's behaviour in order to use it in the design of inclusive environments; this should define the point of departure of any design strategy for education.

The next step in this ecological approach is to propose a new frame for classifying different perspectives in dealing with blindness. This classification does not respond to subjective perceptions, even though it might be strongly influenced by them. This classification suggests four ontological approaches that can be used to contribute to the inclusion of blind people. No one approach is more important than another; each can collaborate with another approach in different situations, and all the approaches often have to interact at the same time. An example of this is when you design a tool that takes into account the limitations inherent to blind students, detected by the medical perspective. This tool is designed with the adaptations required by blind students, but it is also designed in such a way that it can be useful to any student in the class. One example is the idea of adjusting a smart board and enabling it to reproduce orally what is written on it for the students at the back of the classroom.

On the basis of this classification I could argue that offices that support blind students currently are more oriented to the adaptive perspective, while the integrative perspective belongs more to the discourses and law enactments, without clear articulation of the strategies for implementing them. The educational contexts in both countries lack intentional inclusive perspectives. I have to note that inclusion is a process and it does not happen spontaneously overnight; it requires design, intentionality and preparation on the part of the context to have a chance to succeed.

Hence, seeing as UNA has an office for the support of students with disabilities it can be said to have better bases for developing a strategy for achieving inclusion. However, as discussed above, this process may require some basic resources to ensure significant improvements in students' opportunities, and these resources are not provided by this office due to a lack of budget and policies allowing it. On the other hand, the resources provided by Danish state cover these primary needs. However, the fact that there are no disabilities affairs offices in the educational institutions in Denmark could complicate the design process, especially under the premises discussed throughout this research.

Another drawback of the Danish model is that universities are losing the opportunity to complement any process with the university research capacity. Also, as these inclusion processes are difficult to explain to the politicians and difficult to account for in political discourses, it could impose difficulties on a national centralised office trying to justify the use of extra funding to achieve a goal that is not fully clear to people outside academia. Conversely, an office located in the university could easily justify the budget within the limits of their action scope and, as it is a student matter, the justification is built into the essence of what it means to be a university. One potential problem is if the university budget is also limited and the office will need to fight other equivalent projects for funding. Thus, both models have pros and cons, and all of them are governed by political interest. Therefore, researches can provide politicians with clear justifications for prioritising this inclusion process. I hope this research will contribute to this.

It is possible to use the tools in use or tools that have been rejected by blind people to understand blindness. Many tools have been developed for blind users, but not all of them are of interest to the designated users; this is probably because the tool does not solve any substantial situation that justifies the inconvenience of using the tool, or because the state of the technology is not good enough to make the tool useful. Other tools could be outdated, and tools that clearly indicate that the user is blind are usually not well-accepted by the users. Blind people prefer tools that can be hidden and thus do not distinguish them from other people.

Additionally, in order to get closer to the world of blind students, in chapter 5 I briefly reviewed the context of blind students in tertiary education in both Denmark and Costa Rica. I presented a description of the legislation, discourses and support offices in both countries until 2008 as well as internal initiatives in the respective educational contexts.

This knowledge of the context was completed with the ethnographic approach of my fieldwork with the students, producing considerable amounts of information directly from the students, which was supplemented with the experiences of teachers at UNA who shared their feelings, ideas, concepts and fears about having a blind student in their classrooms. From the fieldwork we learned that blind students have adapted to a sighted world: the only way for them to be included into the periphery of mainstream society. Actually, they have done a great job achieving such peripheral participation, because essentially they have done it alone without tools that could have eased their full participation, overcoming many difficulties the hard way. A consequence of the strength of blind people is that they have accepted as a fact that the only way to get into the mainstreams of society is by adapting themselves to the sighted world.

Another lesson learned was that as sighted people depend extensively on sight, merely the thought of losing it produces deep-seated fears that are reflected in sighted people's difficulties in understanding how it is possible to live without sight; this consternation is then transformed into misconceptions and prejudices that are very different from the world of blind students. People had a tendency to forget that blind students in tertiary education have overcome a lot of difficulties to get where they are. The workshops conducted in Costa Rica showed that teachers can resolve the majority of these misconceptions and prejudices by interacting with blind students and learning how they cope with their condition. It took two or three four-hour sessions to reach a different perspective on blindness and to move from 'not knowing how students could study informatics' to 'how teachers could make accessible the system engineering career programme'. They understood that they, the teachers, are responsible for making their teaching accessible to all their students.

Therefore, this research has contributed to the understanding of blindness and, consequently, to answering the question: What does it mean to be blind? The latter is an important sub-question that was approached from various vertices to provide a holistic answer and solid concepts for working with inclusive solutions.

11.1.2. The theory and the inclusion

Obviously, understanding blindness is fundamental also for academic purposes, but in this scope I am also interested in the thesis' contributions to the social theory of learning (Wenger, 1998), showing the versatility of the theory to provide solid frameworks for working within specific educational contexts and for promoting the coexistence of people with different needs.

The first step in Wenger's theory (1998) was to understand the concepts behind the contextual framework of the social theory of learning. In fact, Wenger related his theory to the tensions between different theories: the same kinds of tensions that I suggest exist in an inclusive educational environment. We have learned from this research that solving the tensions between social structures and social constructions of blindness is essential to obtain a balance between the actual context and the context of the blind student.

Moreover, Wenger assigned considerable relevance to the tension between theories of practice and theories of identity, and in this research I have assigned similar relevance to the tension between practices of inclusion and identity construction. In fact, I suggest, as a point of departure for future work on inclusive educational contexts for blind students, the framework presented in chapter 6.

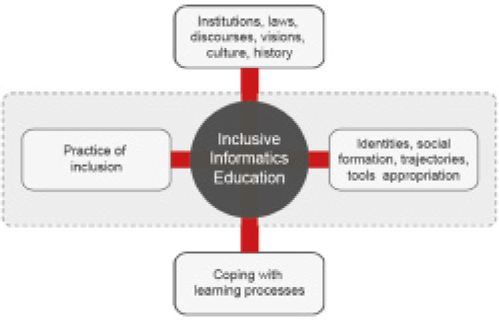

Figure 11.1. Two main axes adjusted to inclusive informatics education.

11.1.2.1. Tensions between social structures and coping with learning

Indeed, this framework describes the tension established between the institutionalised discourses, laws, social construction of blindness with the facilities that blind students have to cope with and which are directly related to their opportunities for studying at university. Today this tension is even more relevant; this research has established that the gaps in the learning environments regarding opportunities for blind students are linked more to improvements in the social perception than to limitations in students' access to curricula contents.

It was clarified that the opportunities of blind students significantly improved the incorporation of screen readers and other tools, easing their access to digital material. This means that the main component for blind students to cope with their blindness, at least to have access to curricula, is digital information. Therefore, with this knowledge the basic step towards facilitating an inclusive environment is to improve the availability of digital contents, and that can be done by working with institutionalised discourses, laws and the social construction of blindness. In one way or another, this improvement is in progress.

What needs to be improved here, particularly in the social construction of blindness, is the general lack of understanding about blind people's needs. I have established that students are so concerned with belonging that they resign to the learning environment that ignores their world and their future incorporation in the work flow. This is the reason why I mentioned earlier in this chapter that understanding blindness is the most important contribution of this research. Beyond this point, what the learning environments need to improve is their understanding of blindness.

Social structures also need to be improved, as we saw support offices focus more on the adaptive perspective; the integrative perspective was limited and the inclusive perspective almost non-existent. The visited educational institutions did not reveal any policies or consistent actions to ease students' incorporation. Even more so, in general they are not prepared to receive blind students; all they rely on is their teachers' past experiences with blind students. Consequently, universities should encourage research in this area as a way to stimulate improvements for blind students. This research should be part of any inclusion process, complementing and guiding a systemic and rigorous process.

Also, I found some discouraging discourses, encouraging blind students to choose certain career programmes which were considered more convenient for them. I might say that the institutions somehow tried to capitalise on the previous experiences of brave blind students who insisted on entering into a specific career programme and thus made it possible for other blind students to enter too. This is a great inconvenience for these brave students, attending an educational institution that improvises solutions to their explicit and external needs, forgetting the more discrete needs for full participation, the negotiation of meanings and identities, spaces for convergence, orientation, reflection and exploration for the sake of their future work lives, discussed in the last chapters, among others.

11.1.2.2. Tensions between practices of inclusion and identity

With respect to the horizontal axis, the tension between the practices of inclusion and identities, trajectories and tools appropriation could be illustrated by the following list of tensions:

- From the intentional design of inclusive practices to the negotiability of identities.
- Around the negotiation of practices and the consolidation of stronger blind identities.
- Understanding of educational needs and sharing experiences and trajectories.
- From Universal Design to the appropriation of tools.
- From designing for learning to demanding more and better participation.
- The confluence of practices and identities, converging in new integrated practices and identities.
- From designing infrastructures, observing the needs of all students.

- Widening the horizons proposed in the educational imagination covering scenarios for all students.

Indeed, some of the findings described in the previous chapters are good examples of these tensions. For instance, we observed blind students who requested a change in practice, but got no answer, forcing them to make an extra effort to overcome the teachers' practice deficiencies; for example, their basic need to have the curricula contents in a digital format was not met. Also, in the interviews the students repeatedly recognised the teachers' lack of understanding of their needs and their lack of interest in learning about blindness. Students said that only few teachers considered incorporating some inclusion concepts into the course contents.

Furthermore, the students said that most of their teachers and peers did not show interest in negotiating practices and identities. This caused blind students to submit their own practices and identities to those of the sighted majority in their attempts to participate. Consequently, as others were not concerned with inclusion or understanding blindness, initiatives for improving belonging by educational imagination were non-existent, constituting one of the greatest deficiencies detected in the educational contexts in this research.

11.1.2.3. What we get from the theory

Finally, the framework presented in figure 11.1 was a valuable tool for this research, and it was supplemented with the collateral tools from the social theory of learning to provide an adequate repertoire and a theory that supported the focus of the data construction and the analysis and provided productive theoretical concepts for reflect on and generalising the findings. As inclusion is a process, and we have established that this process must be designed, the framework and guidelines for a proper design presented in chapter 6 give continuity to this proposed process. Thus, the research contributions could be summarised as follows:

- Wenger's (1998) social theory of learning was used, drawing on the bases of the theory, which has guided the research, the construction of data and the analysis hereof, illustrating its application in the area of blindness. It is a contribution to this theory, as it has not been used in detail before in this context, demonstrating the solidness and versatility of the theory in the diversity of learning environments. As this research used the theory to support explanations of different phenomena, it demonstrates that the theory is consistent and fluent to support studies of the learning environments for blind students. The intertwining of theory, tools and interaction between people is one of the strengths of the theory regarding blind students' worlds.

- The research has generated a solid framework for developing new knowledge of blindness. Future research can draw on a framework that provides tools which facilitate problem understanding and guide the design of inclusion processes. The framework collected the necessary variables for working with holistic, sustainable and integral solutions for inclusion, considering blind students' needs in the broader possible context, assigning responsibilities to the actors.
- Different populations' understanding of blindness is another contribution of this research, providing different explanations of the same phenomena, different perspectives for approaching solutions and different educational tools for facilitating inclusion processes.

11.1.3. Inclusion in tertiary education

In addition to previous contributions with this thesis I expect to provide tools that could be useful to teachers, stakeholders, researchers and any other person who is faced with improving the inclusion process in his or her university, with a pragmatic introduction to the principles of Universal Design and a better understanding of the factors bearing on students' study conditions.

We should start with some assertions from this research:

- Blind students in tertiary education have approved all previous required studies. This seems to be obvious, but the first impressions from the teachers in the workshops showed that it was not that obvious to them; they asked: How are they going to be able to study this career programme?, forgetting that they have been present in educational contexts for 11 or more years.
- Tools are essential for inclusion, but they are not enough. It was clear that education opportunities increased significantly with the introduction of the screen reader; this was also what happened when Braille was introduced almost 200 years ago. But even though these tools contribute to the learning process, there are still more needs to cover.
- Most of the tools belong to the students and not to the educational environments, indicating the dominance of the adaptive perspective in these contexts, as blind students do not shared these tools with the other students. Therefore, in principle, the tools are for blind students only, limiting their participation in the given context.
- Tools mainly respond to the adaptive perspective; few tools respond to the integrative and inclusive perspectives.
- People relay inclusion to third parties. As long as the educational context has access to offices that support blind students and such support focuses on assistance throughout services and tools, rather than achieve better inclusion conditions, teachers will continue to ignore their responsibility to adjust their practices to everyone's needs and they will relay inclusion to these offices.
- In fact, the people who are prepared for inclusion are mostly the blind students and they also need to make improvements. This assertion might seem absurd, but I found that blind students cannot manage all aspects of their inclusion, and in some cases they are not aware of how they can improve their inclusion. This is not only natural, it is also to be expected, because as mentioned above inclusion is a process where blind students are key actors, and although they are likely to understand it faster and easier than others, they should not be the designers of their

own learning environments. This design should come from educational institutions, with student participation.

- Support offices are still very much oriented to the assistive perspective and, to a very limited extent, to the integrative perspective. These offices should understand that their more valuable role is to work on improving the inclusion process. The daily work with supporting students from an adaptive perspective should not overrule the time to establish, guide, support and monitor the inclusion process across educational institutions.
- The drawback of inclusion in tertiary education is the absence of belonging by imagination. As discussed above and in previous chapters, belonging can take place via engagement, imagination or alignment. Engagement and alignment facilitate belonging via the individual effort of blind students, who are interested in belonging. They can achieve this sense of belonging by forcing their participation, their engagement, even though it is not a natural way for them to find security and confidence in the educational context. The problem arises in connection with belonging by imagination, because they are not aware of their opportunities and neither are the people who surround them.
- Inclusion is reached when people, sighted or blind, students, teachers or staff, appropriate the meanings and responsibilities on which educational environment involvement is based. We have discussed extensively the need to understand blindness, to incorporate tools, to design ways to cover the universal needs as far as possible, and the participation of blind students in this process is indisputable. Also, we have discussed the relevance of the trajectories of the students, given that identity formation is an important component of this inclusion process and such formation is an ongoing process, meaning that some changes in the previous educational context are also recommended.

In connection with the interviews I conducted in Denmark I discussed tools that are still missing in the specific area of system engineering. The most obvious tool is an accessible solution for working with UML interfaces. This is an interesting case of accessibility, as the objective of this tool is to incorporate visual interfaces to facilitate communication between sighted clients and sighted system engineers. Consequently, the development of the tool for accessibility should consider both roles. For blind system engineers it is fundamental to have a tool that allows them to generate, read and present graphically the system designed for the clients. A project was working on the implementation of this tool; unfortunately the result was not satisfactory to blind users ("Object Management Group", 2009-a; Brookshire, 2006; Horstmann et al., 2004; King et al., 2004). Concerning the other role, it does not make sense to adopt this tool, as it was created precisely to use graphical interfaces to ease the interaction with users through drawings and visual codes. If the client is blind, graphical interfaces are useless.

Programming is another area that needs to be taken into account. We saw the stress that interfaces caused for Marcus. I might argue that Marcus' reaction to interfaces is likely to be shared to some extent by many sighted students, as this is an aesthetic problem. Blind people would have additional problems with the spatial distribution, but in general many students have problems with the aesthetic aspects hereof. If there is a course that covers this issue, it should be explicit about the rules one must follow to achieve a good interface, helping blind students to approximate good designs. Feedback from third parties is probably required, but this would nevertheless make blind students capable of doing more than would be possible without this instruction. A tool that could support them in the spatial distribution would be useful.

Additionally, as change is a permanent condition in computer sciences, educational environments must be careful to ensure the accessibility of programming languages, including recent versions.

Another important tool is mathematics support. In chapter 4 I discussed widely the need to provide a solution for mathematical notations, to answer the Universal Design concept. In section 4.3.3 I discussed existing and forthcoming tools that presume to solve this situation and should be taken into account in connection with initiatives to produce an inclusive environment.

A qualitative improvement to blind students' opportunities is to introduce policies that highlight teachers' responsibility to support all students, without exception. But as this is a process, a more direct policy should be enacted, specifically to make it mandatory to provide in written material in an accessible format. This enactment should be considered not only for teachers who have blind students in their classrooms, but for every teacher in the educational context, answering to inclusive perspectives.

However, a process where teachers take responsibility for the formation of all their students is important, and a good starting point could be to use as inspiration the workshops in the fieldwork of this research, as they gave teachers basic knowledge of how to guide an effective, inclusive design process. If teachers have no idea of what it means to be blind and how the students enrol in tertiary educational environments with the same institutional limitations as in primary and secondary education, in which they have been successful, it is even more difficult to understand how an inclusive environment can be designed.

Then teachers, stakeholders and the educational context in general need to focus on facilitating the students' belonging in the academic community, and this is what Wenger (1998) calls 'learning architecture'. Thus, he describes that students will need:

1. places of engagement
2. materials and experiences with which to build an image of the world and themselves
3. ways of having an effect on the world and making their actions matter. (Wenger, 1998, p.270,271)

In section 6.2.1 I discussed the theoretical background that supports these requirements, using Wenger's theory and comparing it to situations that concern the possible needs of blind students. In this research fieldwork I had the opportunity to validate the absence of such learning architecture, as:

1. We discovered that students must give up trying to contribute to the places of engagement; they had to submit their practices to the practices of the sighted majority. In general, teachers went about the inclusion discourse without meeting the students' needs. According to the blind students I interviewed, the topic of inclusion was almost never discussed in class, and teachers were not interested in understanding blind people's needs in order to improve their teaching practices or to contribute to the students' future work practices. For example, when neuronal networks were presented with live configurations, representing the neighbourhood, the spatial difficulties of blind students were never considered, and no alternative examples, support or solutions were provided, keeping Marcus disconnected, not only from the subject in question, but also from group discussions.
2. The same example can be used to illustrate the chances blind students had of building a positive image of the world and themselves in their educational environments. Firstly, they maintained an image of limited access to different topics; not due to the nature of the topics, but due to the way the topics were taught. The teachers did not discuss with the blind students the situations they might have to face in their future practices and possible ways of dealing with such situations. A good example is the situation that arose when I talked to the Costa Rican students about their future work as teachers; we talked about how they would go about teaching visually oriented children. They were shocked, because no one had discussed this with them before and they had not given it any thought. We can conclude that belonging by imagination in these educational environments is not a clear option for blind students, as these environments did not provide any links between blind student practices and established practices, nor did they contribute to negotiations of blind student identities with other identity formations. Meanings were not negotiated, and strengths and weaknesses were hidden: important negotiations in preparing the students for their future professional lives.

3. Consequently, the educational environments are not promoting students' cross-boundary pursuits of more inclusive environments. This means that blindness continues to establish a boundary with no broker, no boundary objects, no multi-memberships. In fact, blind students achieve a sense of belonging only by aligning themselves with the established practice, without negotiations or experiences that can prepare them for the real world.

Therefore, an important conclusion about inclusion in tertiary education is that the process of designing inclusive environments has not started yet; teachers have bare introduced weak inclusion discourses. The teachers showed little understanding of blindness; this was clearly and explicitly described in the workshops conducted in Costa Rica, but it was also evident from Marcus' description of his life experiences in his educational context. However, it was also demonstrated in the workshops that such understanding is feasible and could start to be acquired by teachers in three four-hour sessions. The teachers acknowledged at the end of the workshops that they had gained understanding of blindness, which was sufficient for making adjustments to the curricula. They had managed to demystify their misconceptions and produced a basis for working in an inclusive environment. Still, some doubts remained about how they should deal with these students and the tools they would need to cover. It is essential, though, that they had come to understand that such adaptations are the teachers' and the educational environment's responsibility, not the students'. There is a gap between this understanding and the introduction of a Universal Design process, but this first step is fundamental for getting there. This conclusion is based on the fact that even though there are laws in Costa Rica that demand equal opportunities for everyone and discourses all over the world invite actors to be more inclusive, it is virtually impossible to achieve qualitative improvements if this process is not accompanied by the understanding of the actors.

11.2. Recommendations

As discussed above, inclusion is a process, and as such each step towards inclusion should be considered a success.

This process should start in primary education, because an important aspect of ensuring inclusion is related to a strong blind student identity, supporting the necessary negotiation of identities, practices and meanings in the educational context in general. However, it must be made clear that this is not mandatory. In fact, while tertiary system education does not ensure inclusion, the chances of primary and secondary education of succeeding here are not likely to be any better. But inclusion in primary and secondary education is not necessary for implementing a successful process of inclusion in tertiary education. This means that it is natural to start the inclusion process in tertiary education, in a form of circular, top-down feedback process. This process is fundamental, as inclusive environments in primary and secondary education would help promote the opportunities of blind students in tertiary education.

On the other hand, even the design must take blind people into account, answering disabled people's demand: 'Nothing for us without us' (Charlton, 2000). Teachers and stakeholders should be the 'agents of change' in the educational environments. Consequently, they need to prepare for it, and as they are formed in tertiary education, therefore, the responsibility falls in principle within this educational level. This means that it is particularly important to incorporate inclusion practices, beyond simple discourses, into the production of curricula. Indeed, the incorporation of inclusion concepts should be mandatory in all curricula in tertiary education, as every professional should have inclusive practices, firstly because they should develop a professional consciousness about the importance hereof, but also because it is mandatory by law in Costa Rica and a requirement of the commonwealth principles in Denmark. Additionally, according to Cohen (Rosmaita et al., 2006) the introduction of the accessibility concept in curricula does not represent significant changes to the curricula nor to textbooks.

The question is how to start the process in tertiary educational environments. Firstly I will strongly recommend using the kind of workshops presented in this research. They proved efficient in moving teachers towards inclusion concepts, towards introducing inclusion topics into the curricula and being part of inclusion processes in their institutions. Inclusion requires design, and design requires intentionality, understanding and motivation. The workshops were an example of the process that must be followed, as they provided the necessarily tension between reification and participation in order to provoke a significant improvement in understanding blindness. At this stage the teachers probably learned more about what students do not need and less about what they do need, but nevertheless it was considered a great improvement to the inclusion practices of the same participants. This tension stimulated a negotiation of meanings and established the relevance of such negotiations to provide affordance to the educational context. Also, the role of artefacts and people in this process was clarified, recognising that they would need to negotiate in detail different meanings throughout the process.

The tension between the designed and the emergent is essential in the inclusion process. We have to consider in our design the space that allows the emergent to take place. The design should define the guidelines of inclusion, but it should not limit the emergent; it is important not to forget that as soon as we start our inclusion process, our contexts start to change. This should also be considered in connection with research; participatory research is highly recommended, as the emergent takes place in the interrelation between blind students and their educational contexts. Accepting this recommendation would echo the slogan ‘nothing about us without us’ (Charlton, 2000). Another consideration is that the inclusion process is extensive; it does not merely provide inclusion for blind people; it varies with the great variety of special needs. The teaching practices and the disciplines as well as the formation of the teachers are also relevant factors. The focus of the design should be on finding ways to ensure the convergence of practices into a single practice. Such convergence relies on the identification and negotiability of students, teachers and stakeholders, sighted and blind; this is the only way to reconcile the facts of a single inclusive practice. This requires that institutions provide the space and time for participation, for discussion, for sharing experiences, for negotiating meanings, identities and practices, and all of these must be designed.

So far I have based my position on the willingness of the teachers, evoking their teaching vocation, but this is not always enough. Therefore, a second initiative should be implemented to align the discourses of policies to back the inclusion process. Educational institutions should generate policies to encourage teachers, stakeholders and students to participate actively in the process, making the actors aware that a good teacher is good to every student, and teachers cannot deny their individual responsibility in providing all material, examples, concepts, knowledge in multiple means of representations, multiple means of expressions and multiple means of engagement (Rose et al., 2008, p.46).

Special awareness should cover what has been discussed above about the weaknesses in belonging by imagination. Wenger argues:

> If the purpose of education is not simply to prepare students for a specific capability, but rather to give them a sense of the possible trajectories available in various communities, then education must involve imagination as a central way. Students must be enabled to explore who they are, who they are not, who they could be. They must be able to understand where they come from and where they can go. (Wenger, 1998, p.272)

Reviewing this sentence carefully we can identify the relevance of educational imagination for blind students, as these students will be attending an educational context that has been prepared to teach sighted students. If the educational context does not go beyond this and provide alternative trajectories to allow the students to explore their abilities, how to deal with their disabilities or explore their capabilities to overcome limitations through creative solutions or previous experiences, it will become a significant lost of opportunities, particularly, but not exclusively for blind students. Educational support and a strong blind identity will ease blind students’ opportunities to succeed in their future professional lives and it will help them get a better sense of belonging to the educational context.

It is clear that this preparation is relevant not only for blind students but for every student, as they need to see themselves in a projected future, identifying their own abilities, disabilities and capabilities to do whatever they need to do. The difference though is that the educational environment is likely to have received feedback from professional practices and has determined an important set of trajectories available to sighted students; and it is even more likely that they have received less feedback from blind professionals in their practices.

However, if the educational context, responding to this requirement of blind students, improves its educational imagination, it would improve the educational imagination of all students. This is not accidental, as we can list many areas in which improving the accessibility for blind people will improve the accessibility and ease the conditions for everyone. This means that any improvement for blind students would benefit all students. For example, Rosmaita et al. (2006) illustrated how the introduction of a non-standard user model for developing web browsing helped the rest of the students understand the distinction between contents and presentation, achieving a more easy to maintain website. Similarly, Marcus insisted that providing the material in advance in an accessible format would be useful to him as well as to the rest of the students [24B, 140Y, 643B].

Other actions that are also important, but more specific and with alternative solutions include the provisioning of specialised tools for specific areas of the curricula and future professional practices, and in the previous section I discussed the need for a UML tool and a tool to support the neuronal networks course. These tools are important as they increase blind students' chances of full participation, and at the same time they do not limit blind students from studying system engineering.

Mathematics is another area that needs attention. Educational environments should provide accessibility tools for mathematics, as it is convenient to have such standardised tools, at least in the given career programme, as the teachers will also have to practice using these. This is connected with formula representation where it is necessary to be able to translate to and from the native format, using the tool format, keeping the formula unaltered for evaluation or interpretation.

If robotics is part of the curricula, it may require some degree of design to avoid visual references in the functions implemented. However, I do not expect students to have problems with the required abstraction; conversely, I would expect them to produce better abstraction levels due to the training blind people have received to move around.

In conclusion, the inclusion goal for tertiary education is an environment that ensures the full participation of all students, including blind students. Therefore, the answers to the main research question – How can the School of Informatics prepare to receive blind students? – have been summarised in this recommendations section and illustrated throughout the research. Even though some tools still need to be incorporated, it is clear that the preparation for this work is the responsibility of the teachers and the staff, as established above. Certainly, it is possible for the School of Informatics to enrol blind students, and new issues are likely to occur in the process, but this should be part of the inclusive design of each teacher. For example, teachers should find ways to illustrate neuronal networks using alternative examples that do not depend on spatial references.

11.3. Future research

Finally, the results of the research regarding the general framework definition are important in enabling researchers and developers to focus in their work on key considerations established here and continue with further initiatives to complement the findings.

The work to find systematic ways to provide sustainability in the negotiability of identities and practices and the provisioning of time and spaces are important topics for future research. As discussed, a suggestion from this research is to use the workshop format; however, this format relies on the participation of blind students, which entails that the sustainability of this format could be compromised by the number of iterations required and the number of disabled students who agree to participate in these activities.

It could also be interesting to introduce the proposed model for inclusion to other disciplines than informatics and, more importantly, to other disabilities, since the students' needs may vary significantly. In fact, in relation to other disabilities I received some information about deafness in my research; here language and communication might be important facts in trying to ensure full participation. The premises are completely different than for blindness and, naturally, so are the tools; these will differ for every disability.

In computer sciences several research projects could be useful. I have mentioned the importance of developing an accessible UML tool. This research should be careful not to repeat the deficiencies in previous developments (Brookshire, 2006; King et al., 2004). Before a student can even begin to think about writing a single line of code, the real effort is probably accessibility matters. It requires understanding of the spatial difficulties that blind people have. I would advise other researchers to start with Hatwell, Streri, and Gentaz, 'Touching for knowing: cognitive psychology of haptic manual perception' (2003) and Gibson, 'The ecological approach to visual perception' (1979) to get inspiration as to how sighted people can assume as trivial the activities that involve significant effort for blind people, especially early blinds, spatial locations and movements, the different communication media available and their strengths and weakness. The W3C should be a relevant source of information, but working with blind users before and during the research is inescapable.

As highlighted in the recommendations section, interface designs could be improved by a tool that helps blind students with the spatial distribution. The development of such a tool could comprise an interesting research project that would be helpful for sighted users as well. Inspiration for this research can be found in section 8.1.4.4 'Dreaming with new tools' and in Marcus' comments on precisely such a topic in [1912] and [1920].

Regarding social aspects, Cohen (Rosmaita et al., 2006) states that computer science professionals should focus on improving the communication means for people with disabilities in education and research. In professional practices it is necessary to introduce the concept of accessibility in the curricula. In fact, very few computer science programmes address accessibility issues, and its introduction does not represent significant changes to the curricula nor to textbooks.

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APPENDIX A

Informed Consent Statements

Student Interview in English

Informed Consent Statement – Student Individual Interviews

Research Project: How to do a Computer Science School more inclusive for blind students

The purpose of this research is to study the facts and situations that should be considered to easy blind students to study computer science careers at university level. For this stage of the study, I request your participation in individual open-ended interviews regarding your perceptions, thoughts and own experiences of your studies and daily life.

Even the interviews and the research by itself implies a minimal risk to you, the following procedures will be taken to protect you against all risks:

1. Your participation in this interview is completely voluntary. There are no anticipated risks or discomforts related to your participation.
2. You have the right to withdraw from the study any time with no question asked and no repercussions.
3. You have the right to refuse to answer any questions uncomfortable to you during the interview.
4. All participant responses will be completely confidential. Your responses made during the interviews will be available only to the research team. Your name and identifying information will not be used in reports based on this research study. Participants will not be identified in any presentation or publication resulting from this research. The researcher will take the pertinent precautions to protect the identity and information provided in these interviews.
5. You must consider that due to the particular situation of the students and the small population in these circumstances, it could be difficult to guarantee the total anonymity of the student.
6. Your permission is requested to allow the interviews results to be used in the researcher's doctoral dissertation as well as in presentations at professional conferences and publications.

If you have any questions about this research or your participation, now or at any time, please feel free to contact:

Ronald Vargas. PhD Student
Human Centered Informatics, e-Learning Lab
Room 2.006, Kroghstraede 1
DK-9220 Aalborg Øst, Denmark
Phone: +45-9635-7405

If you understand the request and:
- Voluntarily agree to participate in this study;
- and allow these results to be used for the research purposes stated in this consent; then please firm the above consent form:

Consent Form

I, ____ voluntarily agree to participate in interviews and authorize to use the information provided by me, to be use for research purposes set forth in the present form. In addition I declare that:

___ I agree
___ I disagree
to allow the use of images of mine as elements of illustration in the research project.

Date______________ Signature_____________________

Student Interview in Spanish

Fórmula de Consentimiento – Participación en talleres

Proyecto de Investigación: ¿Cómo a hacer la Escuela de Informática más inclusiva?

El propósito de esta investigación es estudiar los hechos y las situaciones que se deben considerar para facilitar a los estudiantes ciegos estudiar en las carreras de informática a nivel universitario. Para esta etapa del estudio, le solicito su participación en unos de los 4 talleres organizados conjuntamente con la Oficina de UNA Educación de Calidad para Todos. Estos talleres serán utilizados como una herramienta de recolección de datos para la investigación en mención.

Aún cuando los talleres y la investigación por sí misma no muestran un riesgo explícito para usted, los siguientes procedimientos serán considerados para protegerle contra riesgos no contemplados:

1. Su participación en estos talleres es totalmente voluntaria. No hay riesgos o inconvenientes anticipados relacionados con su participación.
2. Usted tiene el derecho de retirarse de los talleres en cualquier momento sin tener que justificarse y sin ninguna repercusión.
3. Usted tiene el derecho de rechazar contestar cualquier pregunta o a realizar alguna actividad que le resulte incómoda durante los talleres.
4. Toda la información del participante serán totalmente confidenciales. La información recabada durante los talleres estará disponible solamente para el equipo de investigación. Su nombre e información de identificación no serán utilizados en los informes basados en este estudio de investigación. Los participantes no se identificarán en ninguna presentación o publicación resultado de esta investigación. El investigador tomará las precauciones pertinentes para proteger la identidad y la información proporcionada en estas actividades.
5. Usted debe considerar que en algunas circunstancias, podría ser difícil garantizar su anonimato.

6. Se solicita su permiso para que los resultados de la entrevista sean utilizados en la disertación doctoral del investigador así como en presentaciones en conferencias y publicaciones profesionales.
Si usted tiene cualquiera pregunta sobre esta investigación o su participación, ahora o en cualquier momento, por favor, siéntase libre de contactar al investigador:

Ronald Vargas. Estudiante Doctoral
Human Centered Informatics, e-Learning Lab
Room 2.006, Kroghstraede 1
DK-9220 Aalborg Ost, Dinamarca
Teléfono: +45-9635-7405
e-mail: ronaldvargas@hum.aau.dk

Si usted entiende estas condiciones y:
- acepta voluntariamente participar en este estudio;
- y permite que estos resultados sean utilizados para los propósitos de la investigación indicados en este consentimiento;
Entonces firme la siguiente formula de consentimiento:

Fórmula de Consentimiento

Yo, ____ acuerdo voluntariamente participar en los talleres y autorizo a utilizar la información proporcionada por mí, para ser usada para los propósitos de la investigación dispuestos en esta fórmula. Además declaro:

___ Estar de acuerdo
___ No estar de acuerdo

en permitir el uso de imágenes mías como elementos de ilustración en el proyecto de investigación.

Fecha _______________ Firma ___________________________

e-Learning Lab

Appendix B

Agenda for interviews: Institute for Blind and Partially Sighted28. Institute for Blind and Partially Sighted[29]

Hellerup, Denmark

(It may include some activities on Wednesday afternoon)

In order to understand what a blind student needs to study computer science or informatics careers, I will conduct an ethnographic study inspired in a contextual design methodology, where I will need to understand not only what the students need, but also how these needs will interact with the rest of their context. In this sense, for these interviews I am interested in two levels of information.

We can cover these levels in separated interviews, and I will like to have your recommendations about how to split these interviews between all of you. I do not have any problem to extend the time required to do this, due to these interviews are essential information for my research. So I will be available all Thursday and if it is needed I can be on Wednesday afternoon. Also, it will be interested for me to visit the library I think you mentioned and any other facilities in use by students (laboratories, classrooms, etc).

Objectives of the interviews:

The first level of information is related with how you could support me in the process of finding blind computer-science or informatics students to

[28] Note: The complete recording of this interview is in (Vargas, 2007) Agenda for Thursday 20 of September 2007.

[29] Note: The complete recording of this interview is in (Vargas, 2007)

determine the feasibility to conduct the ethnographic study with students in Denmark. To accomplish this, I will need:

1- To confirm the existence of blind students in careers of computer science or informatics in Denmark.
2- To determine if there are computer science or informatics graduated professionals in Denmark, that had studied being blind.
3- To know which universities and which semester are they currently attending.
4- To confirm if they speak English or Spanish due to my limitations to speak Danish.
5- To know if you have some students personal characteristics, in order to try to define jointly the possible set of students for the study, considering some of the following information:
    a. Aging group.
    b. Loss-sight age.
    c. Cause of blindness.
    d. Special attributes, awards, high recommendations.
    e. Specific abilities.
    f. Other disabilities.
    g. Have attended special schools.
    h. Previous trainings in the use of tools.
    i. Previous tertiary studies.
    j. Social and family background
    k. Health history relevant to their learning process and social live.
6- To confirm their consent to be observed:
    a. At the university (class room, library, work groups).
    b. At leisure time.
    c. At home.
7- To confirm their consent to be recorded or filmed.

To confirm their consent to be recorded or filmed.

In the second level of information, I am interested to obtain data from you as experts involved directly with the students and their academic context, as supporters or counselors. This part of the interviews will be part of the contextual inquiries of my study.

Probably, you are the first contact of the students before getting into the university and therefore, you are playing and important role in the students' life. This will be an open space to discuss how your relation with the students is; also to learn about your goals and how you accomplish them. It will be important to understand the tools and procedures that you follow to interact with the students and which are the difficulties that you have to deal with, but also the gratefully moments that you faced.

In this sense, I am sure all of you have valuable information to provide from different perspectives, different understanding of the students' reality, different techniques and tools; and this will make each interview important to describe the facts related with the students' context.